DEVELOPMENT OF A FUNDING MODEL FOR ALLOCATING CAPITAL GRANTS TO THE FEDERAL UNIVERSITIES IN NIGERIA

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A Thesis submitted in partial fulfilment of the requirements of the University of Abertay Dundee, Scotland, for the award of Degree of Doctor of Philosophy.

This research programme was carried out in collaboration with the National Universities Commission of Nigeria.

August 2000

I certify that this thesis is the true and accurate version of the thesis approved by the Examiners.

Signed [redacted]... *Date:* ...27 August 2000...
(Director of Studies)

ACKNOWLEDGEMENT

All thanks be to Almighty Allah, the Lord of the Universe. The author is grateful to the following:

1. The Director of Studies, Professor Susanta Sarkar as well as the Dundee based supervisors: Dr. David J. Blackwood, Dr. Harry Staines, Dr. S. Howe and Mr. B. Crabb for the academic leadership and guidance they provided throughout the course.
2. Officials of the Scottish Higher Education Funding Council (SHEFC), the National Health Service (NHS) and the defunct Common Services Agency for providing vital information on policies, procedures, space standards and monitoring strategies. The assistance on information retrieval offered by the Library of the University of Abertay was immense.
3. Professor E.A. Adeyemi of the Federal University of Technology, Akure, Nigeria, who acted as the Nigerian based supervisor and who was also present in Dundee during the defence of the thesis.
4. Mr. Forbin Nkembeng, of the Kaduna State Polytechnic, Zaria, Nigeria who helped in advising on the statistical aspects of the work.
5. Professor Donald Ekong, former Executive Director, Association of African Universities (AAU) for the insights he provided through interviews and discussions on the general funding trends of African universities.
6. The National Universities Commission, Abuja, Nigeria, for her primary role in financing the research in the form of (fees, books, air passages, secretarial support services, etc). The roles played by the former and present Executive Secretaries of the Commission, Professors Idris Abdulkadir and Munzali Jibril, are greatly appreciated. The Librarian

and staff of the NUC Library also assisted in providing literature support materials.

7. The Education Tax Fund (ETF) for the general financial assistance during the period that I served them. The former Executive Secretary of the Fund, Alhaji Tijjani Abdulkadir, also provided logistic support for the realisation of the project.

8. The Vice Chancellors and Staff of Physical Planning Units of Federal Universities in Nigeria located at: (*first generation* – Ibadan, Nsukka, Zaria; *second generation* - Calabar, Jos, Maiduguri and Sokoto; *third generation* -Akure, Bauchi, Minna, Yola) for providing all the relevant data used for the analysis and modelling.

9. Dr. Abdulrahman Sambo of the National Universities Commission (NUC) for his personal support in providing computer hardware facilities, and Dr. Aminu Mamman Ibrahim also of the NUC for his guidance on the use of computer software facilities.

10. Messrs Emmanuel Ogundele, Stephen Awosusi, Ambrose Adetimehin, Ezekiel Chirwa, Usman Abdullahi and other secretarial staff of the National Universities Commission for their untiring and selfless professional services. The assistance received is also appreciated from Adamu Aliyu Shika and the entire staff of Perfect Design Computers, Zaria, Nigeria.

11. Dr. T.C. Mogbo, Chartered Quantity Surveyor, of the Federal University of Technology, Minna, for his comments and general advice.

12. My wife, Maryam Ibrahim as well as my children, particularly, Aliyu Ibrahim, for providing me with the highest degree of motivation, support and encouragement needed to complete the programme on schedule.

ABSTRACT

The Nigerian University system enjoys the block grant funding policy, for both recurrent and capital funds. Unfortunately, the allocation of capital grants was never based on scientific parameters right from inception thereby necessitating the research work. The main aim and objectives of the research were to develop a more equitable model for the allocation using acceptable parameters. Condition surveys were conducted to obtain information on: ages of selected buildings, floor areas, years of commissioning and years of last renovation. Eleven out of the twenty-one Federal universities selected on stratified sampling basis, were used to assemble the primary data as at 1997. The main assumptions imposed on the data on the buildings were: no remarkable differences in: (i) height and shape, (ii) location and climatic factors, (iii) labour and management policy.

Multiple Regression Analysis was used to develop a linear allocation model which enabled some predictive transparent variables to be developed and was used to estimate the cost of repairs for the existing building stocks. A predictive linear model with goodness of fit value (R^2) of 81.55% was developed which provided a basis for allocating available capital funds among the universities.

It was recommended that, for practical purpose, the method of capital funds allocation should have the combination of formula and non-formula driven components. Modified forms of the model can be used in policy issues on building maintenance allocations for other tertiary institutions in Nigeria, and in other African countries. The research work points out the need for: (a) the establishment of modern maintenance information system in all the Universities with a central database at the National Universities Commission, Abuja; (b) the introduction of independent contractor/consultant-controlled Facilities Management outfits for each University; (c) educating the Universities on the new fiscal allocation strategies; and, (d) developing appropriate linkages with maintenance research establishments.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND OF THE RESEARCH

Funding for higher education has become a global concern. A survey conducted by the World Bank (2000, 1994) indicated that investment in the education sector is in crisis throughout the World. The survey revealed that in all countries, higher education is heavily dependent on government funding and unit costs are higher relative to other segments of the education system. In this period of wide-spread fiscal constraints, both the developed and developing countries are facing the challenges of how to preserve or improve the quality of higher education in an era of compressed education budgets and expenditure per student.

Nigeria obtained her political independence in 1960 from Her Majesty's government of the United Kingdom. The first University-level institution to be established was in 1948. This was a college of the University of London, which was opened at Ibadan. Soon after the independence, the first indigenous University was established at Nsukka in 1960. Between 1960-1962, the University College at Ibadan was upgraded to a full-fledged University, and later, three others were established at:- Lagos, Ife and Zaria. In the year 1970, one more University was established in Benin, bringing the total Universities to six. The Universities in this group are now referred to as "*First Generation Universities (FGU).*"

The oil boom of the early nineteen seventies led to the simultaneous establishment of seven additional Federal universities in 1975 situated at:- Kano, Maiduguri, Jos, Ilorin, Sokoto, Calabar, and, Port-Harcourt. The Universities in this group are regarded (for the purposes of this research), as, "*Second Generation Universities (SGU).*" The democratic regime of 1979 established seven new Universities of Technology at:- Owerri, Akure, Minna, Bauchi, Yola, Makurdi, and, Abeokuta. However, by 1988, the Federal Government converted those at Abeokuta and Makurdi to Federal Universities of Agriculture. For the purposes of this thesis, the Federal Universities situated at Owerri, Akure, Minna, Bauchi and, Yola, are classified as, *Third Generation Universities (TGU)*. The only University in the *Fourth Generation Group (FGG)* is the University of Abuja, which was established in 1988. The *Fourth Generation Group* is not considered in this research. All these Universities are being funded by the Federal Government, and, therefore, come under the direct supervision of the National Universities Commission (NUC). From 1979 to date, some state governments commenced the establishment of their own universities and their funding came from their various state resources without any financial assistance from the Federal Government. In 1999, three private universities were registered by the Federal 'government and licensed as full-fledged universities who also operate without any financial assistance from the Federal Government.

It should be noted that the NUC maintains academic supervision over all the universities whether federal, state, special federal, and, also, the private universities. However, the NUC only administers the financial allocation for physical and developmental purposes to both the conventional and the Federal Universities of Technology. (see Charts 1.1 (a) and (b).

1.1.1 The Nigerian University System (NUS)

Jibril (1999) identified the Nigerian University System (NUS) to comprise thirty Federally funded Universities and Institutions, eleven State funded Universities, and three Privately-owned Universities. All together make a total of forty-four institutions as shown in Chart 1.1 (a)

Chart 1.1a: The Nigerian University System (NUS)

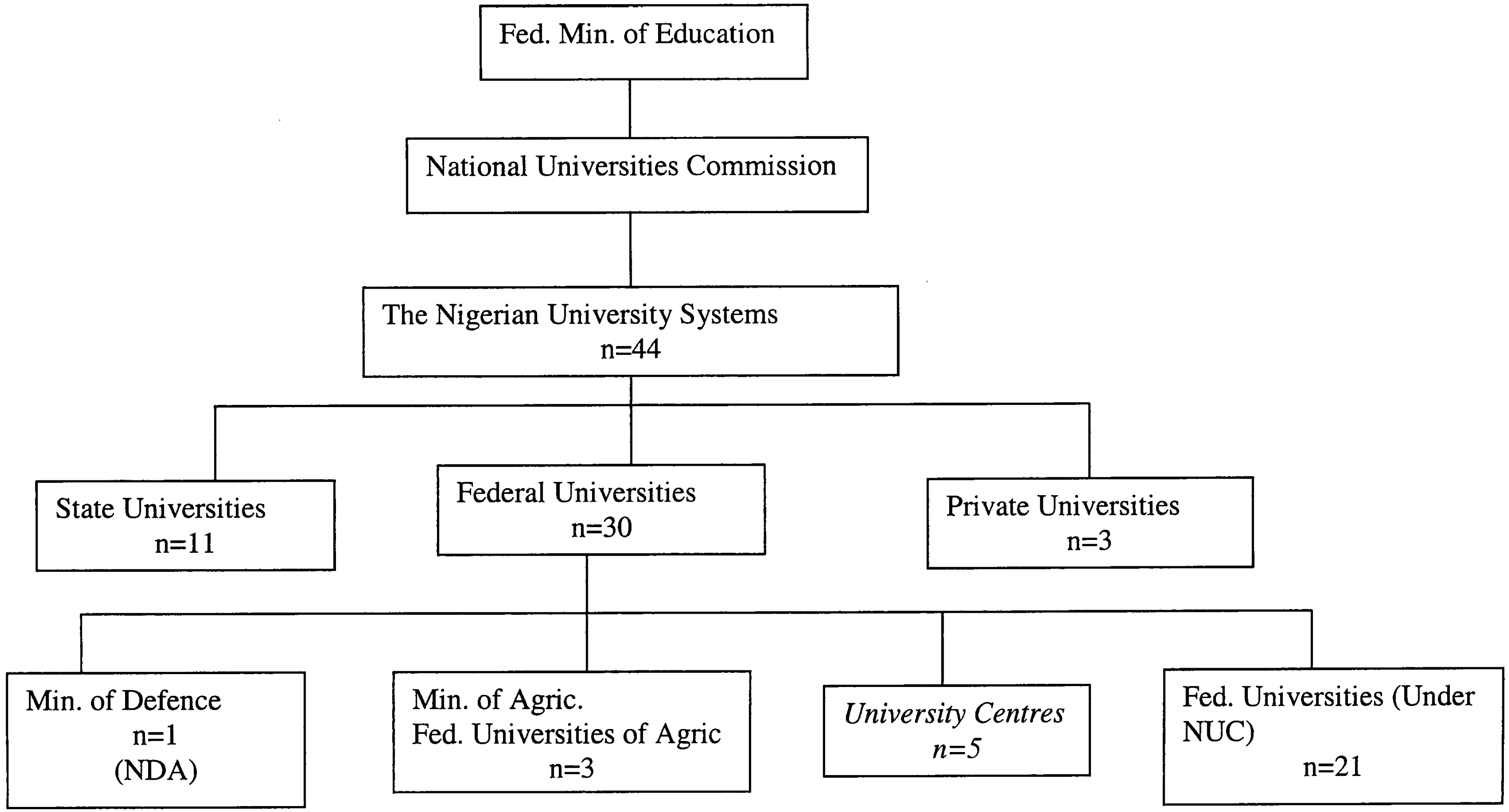
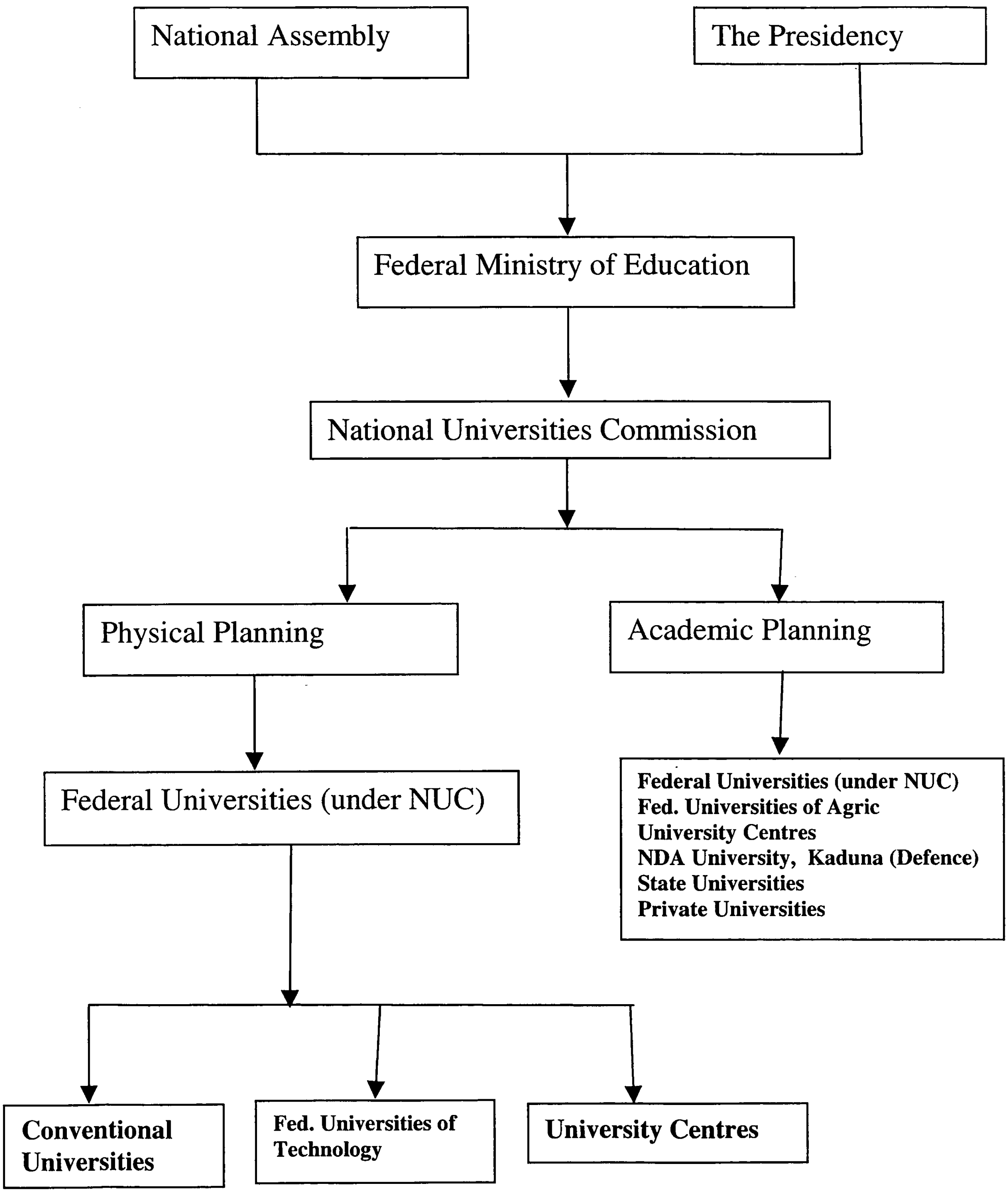


Chart 1.1b: The role of the NUC in the Nigerian University System



Out of the thirty (30) Federal Institutions, only twenty-six (26) were under the supervision of the NUC at the time of this research and were therefore considered. Furthermore, out of these twenty-six (26) Institutions, only twenty-one (21) were full-fledged Universities with full-time students enrolment and were therefore the only ones eligible for the study.

As of January 2000, there were a total of thirty nine Universities and five *Inter-University Centres*. The *Centres* specialise in Mathematics, Agriculture, French, Arabic and the Nigerian languages. Most Universities in the United Kingdom (UK) and other developed countries are situated within the city environment which allow them to enjoy and utilise the city municipal services such as electricity, water supply, telephone services, roads and other infrastructural facilities. This is contrary to the situation in the Nigerian system where the Universities are located far away from the urban centres and have to provide all facilities for their communities including staff housing, primary and secondary schools. The situation therefore contributed to the high annual cost of maintaining a university campus in Nigeria. The cost of municipal services alone in some of the Universities account for up to 15% of their total recurrent expenditure per annum (Omoregie and Hartnett: 1995).

In February, 1995, a World Bank team visited Nigeria and examined the national policy on University education, focussing particularly on the Federal Ministry of Education, Finance, the National Universities Commission (NUC) as well as the universities. The team also studied the problems associated with governance and management of the universities in the context of the current crisis in higher education and later, made some recommendations. The team noted that there was a lack of substantiated data to support policy recommendations and that that contributed to the NUC's inability to focus on solution to the pressing crisis in higher education. In funding Universities by block grants, the team considered that the money was arbitrarily allocated by administrators, who favoured particular individuals and groups. The team further observed that greater trust within the system might result from the introduction of a more transparent process, (Hayward and Gana; 1995).

1.2 PROBLEM STATEMENT

The financial effect of location of the Nigerian Universities began to show as far back as 1958. The World Bank Report (1987) on financing of Nigerian Universities quoted the speech by the first Vice Chancellor of the University College, Ibadan;

> *"It is salutary to realize that the expenditure in 1956/57 by University College, Ibadan on the single item Maintenance of Grounds and Buildings was more than allowed by the Elliot Commission for the entire annual cost of the University College".*

The National Universities Commission's Report to the Constitutional Conference Committee on Parastatals (1994), summarised the basic problems of the Nigerian University system as that of rapid growth without the supporting infrastructure and funding. That report gave the total students' enrolment in 1962 as 3,646 and 216,200 for the 1991/92 academic session. By 1999, the enrolment was approximately 400,000 students. The number of both academic and non-academic staff also reflected such rapid growth while the total number of universities increased from 5 to 39 within the period. The rapid growth without adequate planning and facilities, perhaps, contributed to the rapid deterioration of the existing infrastructure.

Occasionally, Government set up one investigation panel or the other which recommended the provision of more money as a solution to the Universities' problems. More often than not, the Government accepted the recommendations of these panels and gave the Universities special grants for specific purposes. Unfortunately, (due to delays emanating from bureaucratic bottlenecks), by the time the grants were eventually released, the problems had doubled and the purchasing power of the currency reduced by more than 50%, as a result of high level of inflation.

The Cookey Report of 1981, recommended special grants for rehabilitating the fast decaying facilities on the campuses. Officials of the NUC went round the universities and prepared comprehensive rehabilitation reports. Those reports were submitted in 1982 and the estimated total cost for the rehabilitation came to about ₦486.0 million ($725.37 million) in October, 1982. A four-year delay period for action on the reports was experienced and it was not until 1986, when the former Executive Secretary of the NUC later became the Minister of Education that 100 million ($78.74 million) grant was released. In a similar situation, Akindoyeni (1992), argued that the comparative purchasing power of the money released in 1986, was only equivalent to ₦20 million ($29.8m), (20%) at the 1982 prices.

The Federal Government set up the Longe Commission in 1990 to review the higher education in Nigeria with the view to identifying the problems facing the system and to proffer feasible solutions. The Committee visited some universities both in Nigeria and abroad. At the end of their visits, the members were disturbed by the high level of infrastructural deterioration in the various institutions visited. The Commission observed that Nigerian universities had established academic standards comparable to the best in other parts of the World, despite the deteriorating physical conditions of the infrastructure. During the visits to various higher education institutions in Nigeria, the Commission was appalled by the following physical conditions of most of them: (a) dilapidated workshops equipment in most campuses, (b) inadequate facilities such as libraries, lecture rooms and laboratories, (Longe Report; 1991).

The Commission therefore recommended that some capital grants be given to the Universities to rehabilitate their facilities. Special capital grants of ₦420 million ($43.17 million) and ₦475 million ($24.04 million) were therefore released in

1990 and 1992 respectively. In spite of these grants, the universities complained that they needed more money to effect the complete rehabilitation of the deteriorating facilities.

The fundamental question, therefore, was whether the federally funded Nigerian universities required substantial funds determined through empirical reasoning for physical improvement and for maintenance. This was what the present research planned to address with a view to finding appropriate solutions to the existing resource allocation methods.

1.3 THE NEED AND JUSTIFICATION FOR THE RESEARCH

The National Universities Commission (NUC) was established in 1962 as a result of the recommendation of the Ashby Commission Report, submitted to the Nigerian government in 1959. The NUC was charged with the responsibilities of advising Government on the financial needs of the Universities and to handle the planning of a balanced and co-ordinated development of University Education in Nigeria. These functions were further expanded at the promulgation of Decree No.1 of 1974, making the NUC a statutory body. The Decree not only empowered the NUC to enquire into, and advise, Government on the financial needs of the Universities but also to receive block grants from the Federal government (recurrent and capital) for allocation to the Universities in accordance with such formula that may be agreed with the Federal Executive Council.

In 1978, the NUC established a set of parameters such as number of students, staff/students ratio and so on, which were used for allocating recurrent funds to the Federal Universities. These parameters were revised in 1987 and approved by Council of Ministers at their meeting on Thursday 24th May, 1990. Allocation of recurrent funds based on these revised parameters commenced with the 1991 recurrent grant. The NUC again set up another Committee in 1994 to check and revise these parameters in line with the present priorities, and government policy. The Committee submitted its report in 1996, which was approved and is now in use.

Allocation of capital funds to the Federal Universities on the other hand, has never been based on such parameters since the inception of the NUC. This research hopes to investigate and recommend rational parameters for the allocation of capital funds to the Federal Universities.

Such parameters for allocation of funds for both recurrent and capital share need to be constantly revised and updated in order to take care of changes and new developments within the system. In 1993, the former Secretary of Education, Professor A.I. Imogie observed that the substantial increase in both capital and recurrent allocation would require constant revision of the existing criteria for fund allocation.

The parameters for allocating funds should ensure equity among the various universities and should also encourage Universities to work efficiently and effectively towards the realisation of their set objectives. Abdulkadir (1990), emphasized that the parameters should take into consideration, changing national policies on educational development.

The lack of a rational basis for allocating capital funds has been a source of concern to the operators of the University system for quite sometime. Azu (1981) had observed the need for a scientific approach to judiciously allocating the scarce national resources being assigned to the University sector in the form of capital grant, which will guarantee judicious disbursement. He also pointed out that it will be the only way the nation can get value for its money.

In 1982, a first attempt was made to allocate capital funds on rational basis. During that period, the estimate committee of the NUC Board in 1982 submitted three different options to the meeting of the 21st Statutory Commission which was led for allocating capital funds to the Federal Universities. The NUC considered and approved one of the options based on the fact that it showed an average proportion of 51.15% of the grants relative to the total requirements of the universities. Although that option was approved, some members of the Commission, raised a number of observations, which indicated their level of dissatisfactions with the approach.

The apparent dissatisfaction and lack of dependable method of allocating capital grant put the then Executive Secretary, Alhaji Yahaya Aliyu in a difficult situation when presenting capital submission to a meeting of the 22nd Statutory Commission which was held in October, 1983. The Executive Secretary emphasised thus:-

> *"a capital budget of ₦0.7 billion ($972.22 million) put up by the Universities for 1984 fiscal year could not in all honesty be defended ...... the recurrent grant was done more scientifically and could be defended without any embarrassment"*, (Aliyu, 1983).

In 1983, the present method of allocating capital funds to Universities based on their years of establishment and academic similarities known as the Generation Method (GM) was started. The method categorises the Universities into first, second and third generations depending on their dates of establishment. In a document presented to the 28th Statutory meeting of the Commission in April 1985 (using the *generation* method), the Chairman of Estimate Committee informed members that each category was regarded as unique. He summarized the submission as follows:

(i) The Federal Universities of Technology (FUT) were accorded the highest premium in the allocation of capital grant because of their peculiar problems of location on temporary sites. They need to have the highest allocation since they have to develop their permanent site following the Commission's directives and also, not to incur further expenses on those temporary sites.

(ii) The second premium went to the *second generation* Universities whose accelerated academic growth implied an accompanying demand for physical facilities.

(iii) The *first generation* Universities were accorded a lower position in allocation than the first two groups as they were mainly expected to stabilise their academic growth.

Since 1983, the NUC has strictly adhered to that method of capital fund allocation despite its non-scientific basis and the non-recognition of the changes in circumstances over the period. That method of fund allocation has been receiving severe criticisms from many interested stakeholders.

The 1987 World Bank Report criticized the method of allocating capital grants based on age rather than approved building programmes. The report argued that the method does not reflect the Universities' needs. The Chairman of the Seventh Statutory Commission, Chief Gray Longe, also made a severe criticism of the method. The minutes of 47th Commission meeting (1994) stated that "the Chairman of the Commission wondered why Universities of the same generation were allocated the same grant when their problems were not the same". The need for the evolution of an acceptable formula based on some physical parameters, which would assist in allocating the available capital fund equitably among the Federally funded universities, cannot therefore be over-emphasized. That concept may then be in line with Azu's (1981) recommendation that "an equitable formula has to be found for disbursing the limited financial resources to the Universities. The formula must be flexible to take account of changing circumstances".

1.4 THE AIM OF THE RESEARCH

The main aim of this research work is to critically review and analyse the pattern and methods of allocating capital grants to the Federally-funded Universities in

Nigeria with a view to finding the parameters for equitable capital fund allocation method and to develop a more equitable model for allocation. It also aims at, (i), establishing a framework for the creation of a reliable database through the inventory of physical facilities in the Federal universities, and, (ii) finding an appropriate and accurate model for estimating cost of repairs and maintenance of buildings for each university.

The review involves the consideration of historical cost data of capital allocations to the Federal Universities. Similarly, the analysis involves statistical reviews of the enrolment pattern as well as establishing the relationships existing between the funds allocated and the students' enrolment. Considerations shall be given of the pattern of allocation involved in the comparison of periodic allocation of capital funds to the different groups of the Universities, (such as the first, second and third generations) to see if a particular sequence was observed. Finally, the methods used to allocate capital funds to the institutions in 1996 and 1997 were considered. The overall objective of the work will be to establish a scientific method of capital fund allocation to the Federal universities in Nigeria.

1.5 THE RESEARCH CONCEPT

1.5.1 Development of the Research Hypothesis

Blackwood (1998) reviewed the work of Hughes (1994), and suggested two criteria which must be met in the definition of an appropriate Ph.D programme. These are, (a) strategic and tactical factors, and, (b), achievability. The idea of "strategic and tactical factors" involve the value of the research and originality of contribution to knowledge that will arise from the work. The value of the research to the NUC was very clear as it provides a solution to the problem of allocating capital grants to the Universities. The value to the Universities (beneficiaries) was also clear, as the work provides transparent and measurable, parameters of capital fund allocation.

The second criterion, "achievability" was ensured through the development of a hypothesis that was tested to an appropriate degree of acceptability, which facilitated the achievement of the specified aim.

Furthermore, Hughes (1994) classified research work into three distinct categories as follows: (a) "*exploratory*" research which is generally concerned with tackling new problems; (b) "*testing-out*" research which deals with the development of general conclusions arising from previous research and, (c) "*problem solving*" research where the objective is to produce a solution to a practical problem.

This research work falls within the last category, as its intention was to help in solving the long-standing problem of capital fund allocation of the Federal Universities in Nigeria.

It should be noted that since the inception of the Federal University system in 1948 and the creation of the NUC in 1962, no strategic framework or model had been devised for fund-allocation. This research work would, to a large extent, provide a workable model that would assist in policy formulation in the fiscal administration of the physical development programmes of the Federal Universities in Nigeria.

1.5.2 The Hypothesis

This Research is aimed at developing a model that would allocate the available capital funds to the Universities equitably. The hypotheses for the work, which are to be tested, are therefore as follows:

1. The present method of allocation by the "generation" or age of the Universities is equitable (null hypothesis).

$$H_o = 0$$

2. The alternative hypothesis (which is the hypothesis for the work) is that the present method is inequitable

$$H_1 \neq 0 \text{ (not equal to zero)}$$

In the statistical analysis and hypothesis testing, $H_o = B_o$ and $H_1 = B_1$

The hypotheses to be tested are therefore

(i) $B_o = 0$ - Null hypothesis

(ii) $B_1 \neq 0$ - Alternative hypothesis

The following aims were therefore established:

(i) To critically review and analyse the existing patterns of allocating capital grants to the Federal Universities in Nigeria, and, (ii), To identify appropriate parameters of capital funding and hence to develop a more equitable, funding model for future application.

1.5.3 Constraints, Limitations And Assumptions

The major constraint for the work was the availability of relevant secondary data on similar work in the Nigerian University System. This was in view of the fact that not much research work was done in this area here in Nigeria. However, the initial study in the U.K. and the review of literature and relevant models developed by other countries of the world, provided the necessary support.

As there were already developed parameters for allocating Recurrent, Library and Research Funds, only Capital Grant was considered for the development of the model envisaged in this thesis. Additionally, as the capital fund was divided into 60% for rehabilitation and new works, while 40% was fixed and reserved for Teaching and Research Equipment, which was monitored separately, only the 60% component was considered. Furthermore, as the capital grants to the State and other Privately owned Universities were not certain annually, this work was limited to the Federally funded Universities in Nigeria only.

Essentially, the prime conditions imposed on the improvement of the model input are as follows:

(i) **Height of building**

Based on the uniform standard of the University buildings in Nigeria, the average height of the buildings was considered to be two floors of three (3.0m) metres each (total of 6.0m). It was therefore assumed that effect of height will have little influence on the result.

(ii) **Shape of the buildings**

Shape of the building will have no substantial effect on the result, since over 90% of the buildings under consideration are rectangular in vertical and horizontal cross-sections.

(iii) **Location, Climatic factors and Management policy**

The effects of (i) different geographical locations (ii) climatic factors and (iii) management policies are assumed to be the same within each group of the university "*generation*".

(iv) **Labour**

The qualities of labour inputs are equal at various times and at various locations in Nigeria

1.5.4 The Significance Of The Research

The work may establish a rational basis of allocating the available resources in the form of capital grants to the deserving universities based on their actual needs rather than on political or other considerations by providing the following information: (i) qualitative evidence that will lead to the selection of an appropriate form of cost model, (ii) qualitative evidence that may assist in developing a cost allocation model using the available data, and (iii) qualitative and quantitative evidence that could contribute to a greater extent in allocating capital grant to the Universities on a more equitable basis, within a reasonable degree of accuracy.

In addition, some more useful guidelines may be evolved for management policies by providing necessary framework for highlighting (in the context of the Nigerian University system), the following: (a) national priority projects, (b) national strategic pilot project, (c) standard allocation, (d) new buildings, (e) reward or incentive for efficiency, and, (f) effective ways for instituting facilities management programme for the Federal universities and other tertiary institutions in Nigeria.

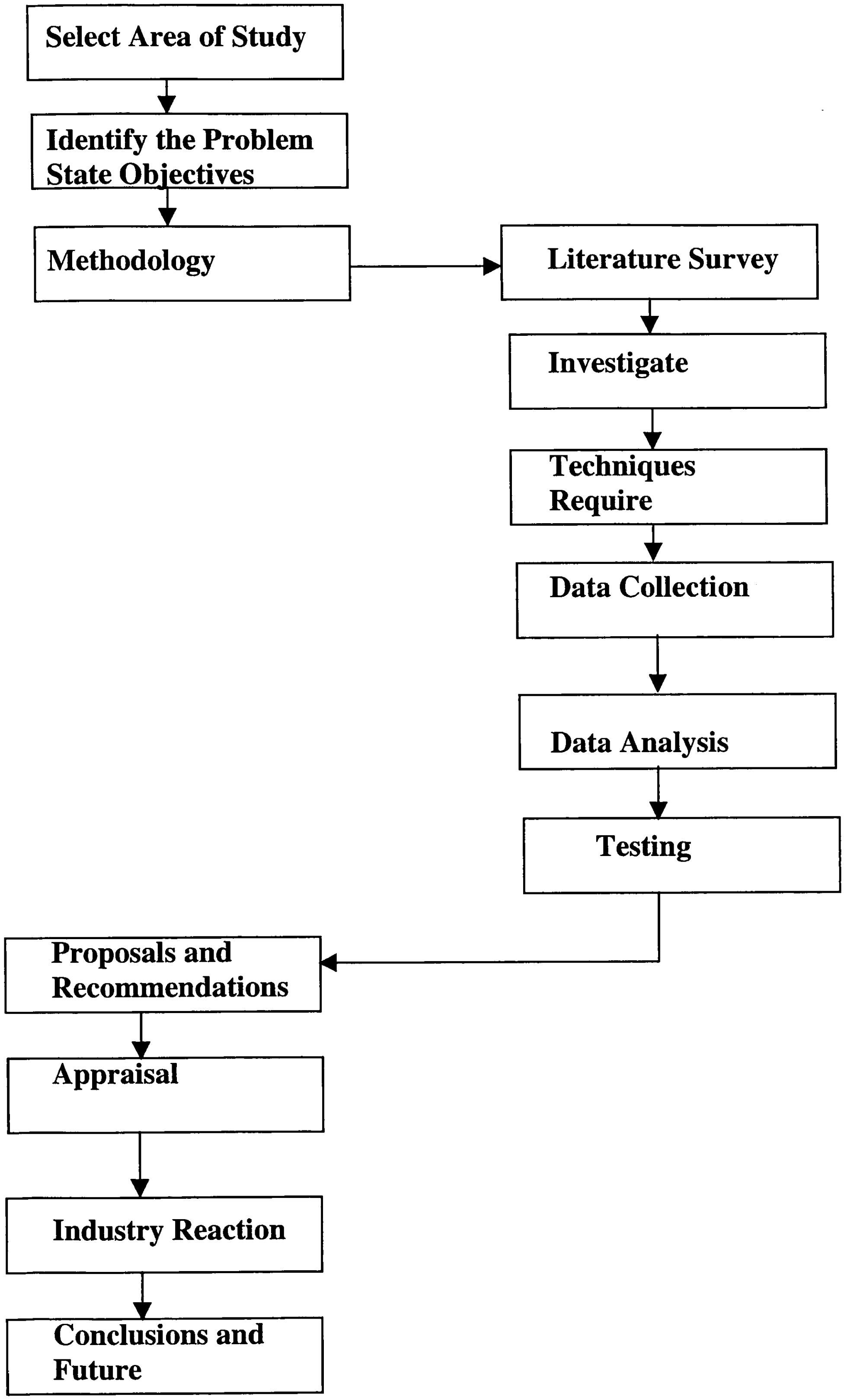
The results and recommendations from this research work may likely be of use to some parallel supervising education Commissions in Nigeria, for example, the N.B.T.E. (The National Board for Technical Education which supervises the polytechnics), the N.C.C.E. (The National Council for Colleges of Education which supervises the Colleges of Education). Both the polytechnics and colleges of education appear to have similar problems with the universities. This research outcome may therefore, be of wider application to the education sector in Nigeria, and, perhaps, to other developing African countries.

1.6 METHODOLOGY

1.6.1 The Research Process and background

Ashworth (1988 p.291), described Research as the acquisition or finding out of scientific knowledge on factual basis. Gill and Johnson (1991) enumerated the seven steps involved in conducting research and described the research process as shown in Chart 1.2.

Chart 1.2: The Research Process



A research process commences with the selection of an area of study. The second stage, to follow is the problem identification. Once a problem has been identified, a methodology to tackle the problem is immediately developed. Literature search will then be conducted; relevant data collected, analysed and tested. The next step involves the use of all the analysed data to make recommendations. The final step involves the appraisal of the recommendations and getting reactions of potential users. Conclusions are eventually drawn up and suggestions for future research evolved.

Following the research process adopted for this study, the first step was achieved in 1995 when the decision to look into the area of capital fund allocation for the Federal Universities was taken. A research proposal was submitted to the University of Abertay, Dundee which was subsequently approved.

The second step was followed by the three months full time study at the University of Abertay, Dundee from November, 1995 to the end of January, 1996. Activities during period involved extensive literature search, collection of secondary data from the United Kingdom and the development of questionnaires. On return to Nigeria, data was collected from the Federal Universities starting with an initial pilot study of three Universities.

In order to ensure success of the study, the aim of the study was divided into two components as follows:

(i) To critically review and analyse the existing patterns of allocating capital grants to the Federal Universities in Nigeria. This aim was adequately achieved at the end of the M.Phil. Study where a weighted space (interim model, using the full-time equivalent students and the space requirement) was developed. Approval to proceed to the Ph.D level was granted in June, 1998.

(ii) To identify appropriate determinants or parameters of funding, and, hence develop a more equitable funding model for future application. This aim was achieved. The primary data collected and the parameters developed have been described in Chapter 5.

1.6.2 Approach to the Study

'Procurement' is the term used in the construction sector to describe the total process of meeting the client's (building owners) need for a new building or the refurbishment of an existing building, starting at the point where the need is first expressed.

In order to develop the new model, a need for effective comparison of procurement method between the University system in the United Kingdom and other developed countries with that of Nigeria was identified and a careful plan of how to approach the study was arrived at. The study was executed by:

(i) conducting a comprehensive review of developmental stages of Universities in the united Kingdom and other developed countries, during the three months full time study in Dundee.

(ii) holding discussions with officers in charge of physical facilities in the University of Abertay, Dundee, on issues relating to capital fund allocation, space allocation and utilization, tendering methods and procedures as well as maintenance policy and procedures in the university.

(iii) holding similar discussions with officials of St. Andrews University, Scotland,

(iv) holding discussions with officials of Scottish Higher Education Funding Council (SHEFC), National Health Service (NHS) as well as Common Services Agency on policies and procedures, space standards and monitoring strategies,

(v) conducting extensive literature search using materials from the University of Abertay (UAD) Library and the facilities available through the Inter

Library borrowing in the U.K. and the on-line Inter-Library computer facilities. The literature search was focused on resource allocation methods (theoretical and practical economic models), space allocation and utilization records as well as building maintenance policies and approaches,

(vi) similar literature search on materials relating to the Nigerian University system and discussions with responsible officers in the Nigerian University system including Vice Chancellors of some Universities (Akure, A.B.U. Zaria, Bauchi, Ife, Nsukka, Owerri and Yola), were also held,

(vii) development of questionnaires for data collection from the Nigerian Federal Universities in relation to existing spaces, condition of facilities, student enrolments allocation as well as other factors affecting capital development,

(viii) holding interviews with the past Executive Director, Professor Donald Ekong (Association of African Universities), which is an organization with its headquarters in Ghana, with membership comprising all African Universities on the general system of fiscal allocation as well as of physical development strategies adopted in other African universities. Such interviews helped to provide some background information suitable for the formulation of a testable framework for fund allocation and for physical development strategies of federally funded Nigerian universities,

(ix) From the literature reviews and data analysis, appropriate financial modelling techniques were identified. There was an imperative use of computers in data analysis,

(x) developing weighted space (interim) model using data from secondary sources. Later, a linear allocation model using the data from primary sources, was developed,

(xi) the two allocation models developed in (x) above, were verified and both proved workable,

(xii) finally, the primary data was used to explore and confirm the possibility of developing a probability model using simulation modelling approach, for maintenance projects.

1.6.3 Research Procedure

Data on the following were collected using structured questionnaire from:

1. Selected Universities.
2. Estimated cost of repairs.
3. Floor area of the buildings.
4. Condition of the buildings.
5. Age of the buildings.
6. Number of blocks.

The data were further classified into three previously stated "generations" of Universities:

First Generation (1948 – 1970)

Second Generation (1975 – 1980)

Third Generation (1980 – 1983)

The data were subjected to statistical analysis using Multiple Linear Regressional statistical methods as the prime instrument for constructing an acceptable model.

1.6.4 Plan of the Study

(i) **The use of action research method**

Action research method was employed to build up case materials from which generalization was made:

Action research strategy was considered suitable for the topic and subsequently adopted for the work. Gill and Johnson (1991 p.59) described that the main feature of action research to include focussing on the effects of that action by understanding the dynamic nature of change and studying it under controlled conditions as it took place. From their intervention and subsequent evaluation, action researchers intend not only to contribute to existing knowledge, but also to help resolve some of the practical concerns of the people or clients who are trying to deal with a problematic situation.

Action research method has been recommended for use as a means of solving practical problems. Bajah (1994 p.40), stated that with the regular availability of research funds, universities in the remainder part of the decade were advised to carry out focus or action research on issues, which are relevant to the country.

(ii) **Literature reviews**

Literature reviews centred on the various methods adopted by researches who had handled problems with varying inputs as considered in this research. Also, reviews were undertaken of the main findings on some important components in the model input such as (i) age of buildings, (ii) deterioration of materials, (iii) general maintenance: methodology and management, and, (iv) facilities management

(iii) **Sampling Strategy**

Selective sampling strategy was used for the collection of primary data. Samples of the eleven Federally funded universities were considered. The samples cut across the official classifications of the universities, as described in Chapter 6, for example, the classifications were enlisted in strategical formation, thus:

- *First Generation* – All universities established between 1948-1970
- *Second Generation* – All universities established in 1975
- *Third Generation* – All universities established between 1980 and 1982

(iv) **Data Collection**

Two types of data were collected for this Research work. They include:

(a) **Secondary Data**

This was in the form of published work, special reports and other relevant information available in the UK, the NUC, the Universities and other Agencies of Government in and outside Nigeria. The data include the student enrolment, full-time equivalent (FTE) space standards for teaching and research as well as residential facilities.

(b) **Primary Data**

Structured questionnaires were used to collect the Primary data for this work. A condition survey of existing building stocks was conducted in the sampled Universities and has been fully described in Chapter 6. The data collected for each building include name of the building, the block number, total number of blocks within the faculty, age of the building, total useful floor area, year of commissioning the building, year of last renovation and the assigned condition given to the particular structure.

(c) **Validation of Data**

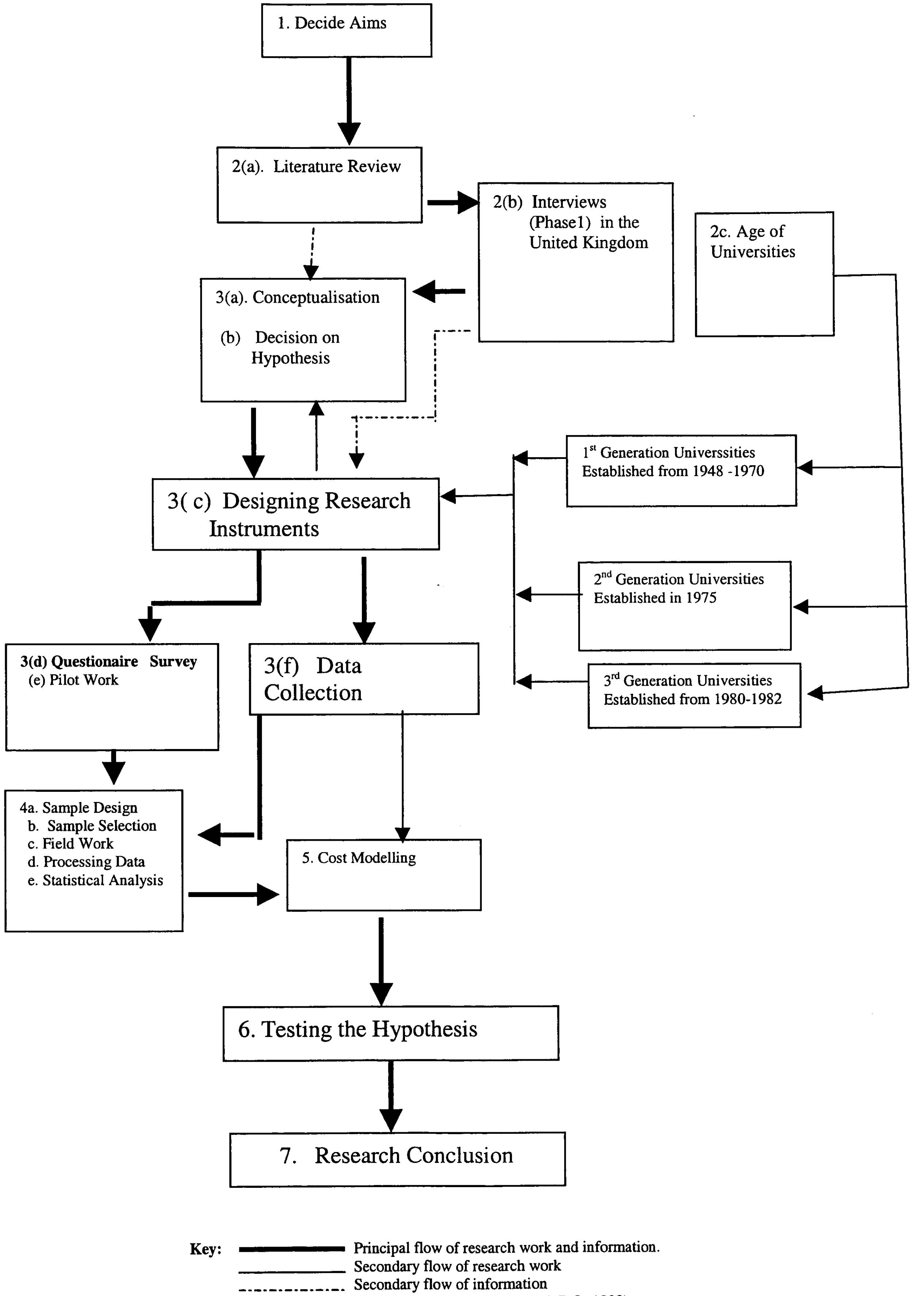
The sampled Universities were visited to conduct physical assessments of the submitted data in order to establish data integrity.

(d) **Data Analysis and Recommendations**

Statistical Package for the Social Sciences (SPSS) was used for the analysis in order to establish the statistical relationships existing between capital grant allocation and the variables/parameters used at different times. A model was developed for allocating capital grants based on the findings. Final recommendations were made and suggestions for further work provided.

Chart 1.3 – "Plan Of The Study" indicates diagrammatically, the plan of the study as discussed above.

Chart 1.3:- Plan Of The Study.



Plan of the Study (Developed from Blackwood, D.J., 1998)

1.7 THESIS STRUCTURE

Chapter **1** of the thesis provides a general background of the research and explains the methodology adopted for the work.

Chapter **2** gives an overview of the Nigerian economy and how it was affected by the fluctuating oil prices at the International market. This chapter also reviews the budgetary allocation policies of the National Universities Commission.

Chapter **3** provides the theoretical framework of the study by reviewing the current literature on resource allocations and procurement methods.

Chapter **4** explains the procedures for building condition surveys, information system for strategic planning, the modelling concept as well as approaches to cost modelling.

Chapter **5** presents the results obtained after the analysis of secondary data which leads to the development of a weighted space (interim) model.

Chapter **6** contains the result of a comprehensive condition survey of existing building stocks in the sampled Universities and the development, as well as the interpretation of the cost allocation models, using linear multiple regression method.

Chapter **7** describes the selection, development and the results of the cost model which was used to assess the feasibility and the potentials of using the simulation modelling approach to arrive at an optimum maintenance strategy for the universities. The use of Monte Carlo Simulation approach to establish maintenance strategy is explained.

Chapter **8** presents a general summary of conclusions and findings from the study and contains a number of recommendations and suggestions of areas for further studies.

Appendices are presented which contain additional information in support of the study. Details of reference materials are also provided at the end of the text.

1.8 SUMMARY OF CHAPTER ONE

The following are the highlights of discussions undertaken in Chapter One of this thesis:

(a) Funding for higher education is heavily dependent on Government, particularly in the developing countries

(b) The National Universities Commission (NUC) was established in 1962 as a body to co-ordinate the activities of the universities in Nigeria. Although the NUC had developed scientific parameters for allocating recurrent grants, it was unable to provide acceptable models for capital grants.

(c) The research aimed at developing an equitable model for allocating capital grants to the Federal Universities. The overall objective was to establish a scientific basis for the allocation of capital grants given to the universities.

(d) Data collected for analysis from selected Nigerian Federal Universities were: maintenance cost, floor area of the buildings, conditions of the buildings, ages of the buildings, and, number of blocks.

(e) Using Linear and Multiple-Regressional statistical methods of analysis as the prime instrument, possible acceptable models were explored.

CHAPTER TWO

2.0 THE NIGERIAN ECONOMY AND THE DEVELOPMENT OF NATIONAL UNIVERSITIES COMMISSION'S BUDGETARY ALLOCATION SYSTEM

2.1 PREAMBLE

The Nigerian economic fortune rested on the policy of "Oil for Export" adopted by the Federal Government since the discovery of oil in commercial quantity. The 1973 oil price shock at the International market turned out to be a dilemma for some people, a blessing to some and lesson for others. Nigerian economy realised oil revenue of $25 billion per annum during the "oil boom", and suddenly, the revenue dropped to about $8 billion per annum, thus bringing the country to a serious financial crisis.

This chapter traces the genesis of Nigeria's economic crises by examining the major constituents of the economy since independence. It discusses the impact and effect of the oil revenue on the economy and finally analyses the National Universities Commission's budgetary allocation policies for the Federal University system and the interdependence with the general economic fortune of the Country.

2.2 THE NIGERIAN ECONOMIC CRISES AND THE COLLAPSE OF THE OIL MARKET

2.2.1 The Economic Crisis

The two major constituents of the Nigerian economy are Agriculture and Crude oil.

(i) Agriculture:

At the time of independence in 1960s, Agriculture was the single largest contributor to the Nigerian economy, accounting for 70.80% of the total foreign exchange earning in 1964 (Ango, 1994). With the discovery of oil in commercial quantity, Agriculture's contribution to the foreign exchange earning progressively declined to a figure of 4.6% in 1979. Among the factors that contributed to the decline were the severe drought of 1972-1974 and the high rate of population growth.

(ii) Crude Oil

Nigeria is one of the oil-endowed nations and is lucky to have the largest oil and gas reserve in Africa South of the Sahara. The total estimated oil reserve of Africa South of the Sahara in 1994 was about 24 billion barrels out of which Nigeria alone had a total of about 20 billion barrels, thus accounting for over 80% of the Africa's total (Aminu, 1994). Nigeria's projected oil reserve for the year 2000 was put at 30 billion barrels (Lukman, 1999).

The quantity of oil produced per day continues to increase from a relatively small value in 1957 to about 500,000 barrels per day in 1967. By August, 1971, the production level had reached 2 million barrels a day, thus establishing Nigeria as a major World producer of oil, (Asiodu, 1994). With this high production capacity, Nigeria joined the Organisation of Petroleum Exporting Countries (OPEC) in 1972. The period also happened to be OPEC's greatest success time, as the oil boom of the 1970's placed OPEC at its monopolistic position in the International energy market. The oil shock of 1973, following the Arab-Israeli war in October, 1973 gave OPEC all its powers at the International market. The organisation (OPEC) applied an oil embargo which shocked the industrialised nations of the Organisation for Economic Cooperation and Development (OECD). Prices of oil at the international market went up by more than 500% within a very short period. Thus, the weighted price of oil per barrel went up from \$12.7 in 1973 to \$52.7 in 1974 (World Bank Report, 1994).

The price of Nigerian oil had afterwards crashed to below $10.0 per barrel at one time but signs of improvement where shown such that by October, 1998, the price of Nigeria's oil was $12.8 per barrel, (Budget speech, 1999) and $24.9 per barrel in November, 1999 (The Guardian, 1999). Similarly, the production and export level suffered the same level of fluctuation, such that the total export level of 384 million barrels of Crude oil in 1970 went to 808 million barrels in 1979. The oil export was 617 million barrels in 1995 (CBN Report, 1995).

The prices and quantities of oil at the International market have been fluctuating and countries like Nigeria that allow their economies to rely heavily on oil revenue continue to suffer the effect of the fluctuation in realisation of their projected revenue.

On the average, Nigeria exports more than 80% of its crude oil, thus making the economy to be dependent on oil export. Similarly, on the contribution of oil to the total Federally collected revenue, $25 billion was collected in 1980, $21 billion in 1981 and thereafter the figures declined to an average of $7-8 billion per annum up to the present moment (Budget speech, 1999). Nigeria can therefore be said to have enjoyed transient oil boom and a protracted economic depression. Over the last 15 years, oil revenue accounted for more than 90% of Nigeria's total export earning, the situation makes it difficult to correctly project revenue target due to the unpredictable nature of the International oil prices. It is therefore difficult to have any meaningful development plan or well articulated resource allocation pattern.

2.2.2 The Impact of Oil on Nigeria's Economy

Over the years, the Nigerian Government utilized the revenue from oil to effect massive construction of some key infrastructural facilities all over the nation. The investments are both in the social and the productive sectors. Unfortunately, the

Nigerian productive sector, especially the manufacturing sub-sector has been characterised by high-level importation of capital goods in the form of machineries and spare parts; it is almost totally dependent on imported raw materials for production. The procurement of these components takes away a substantial part of the available foreign exchange from the economy. The total value of imported machineries and raw materials for the manufacturing sub-sector accounted for about 63% of Nigeria's total import in 1994 and 67% in 1995 (ESR,1995).

From the weak industrial foundation of Nigerian nation therefore it is clear that any adverse situation that affects the foreign exchange earning will totally affect the manufacturing sector of the economy. The resultant effect is that the resources flowing to other social sectors such as education dwindle at an alarming rate.

2.2.3 Genesis of Nigeria's Economic Crises

Oil constitutes the single largest foreign exchange earner for the economy having contributed about 97% of the total foreign exchange earned in 1995 (CBN Report, 1996). The economy further relies heavily on imported machinery and raw materials for the industrial sector as earlier indicated. It is therefore, logical to conclude that any problem that affects oil prices would automatically affect the entire economy.

In 1973, Nigeria being a member of the Organisation of Petroleum Exporting Countries (OPEC) supported the decision by OPEC to place oil embargo in reaction to Egypt's set back in the Arab war against Israel. The oil embargo by OPEC, which Nigeria supported, sent a shock through the heavily industrialised nations of the Organisation for Economic Cooperation and Development (OECD), and drove prices of crude oil upward by more than 500% within a short period (Sobowale, 1994). Oil producing nations (OPEC) experienced an unprecedented rise in their fortune from the oil revenue. Within a short period, Nigeria's external earning multiplied and a huge external reserve was built up. The oil boom era had thus arrived and the spending spree started. Unfortunately, OPEC leaders assumed that they would have the upper-hand for ever because of political immaturity and absolute lack of understanding of the business game.

Unknown to them, their trading partners, the industrialised nations (OECD) members, who were actually caught unawares by the OPEC's price sting of 1973, had quietly and determinedly embarked on strategic planning to get out of their problems, recover their losses as well as to regain control of the International market. The three strategic approaches adopted by the industrialised nation, were as follows:

(a) Reduction of dependence on oil, especially the OPEC oil.

(b) Efforts to increase the quantity of manufactured goods to be sold to the OPEC members by the industrialised nations.

(c) Strategic focus on OPEC's weak link in order to take competitive business advantage.

In the effort to reduce dependence on OPEC's oil, the industrialised nations embarked on the development of strategic energy saving technology, increased oil exploration in their nations and non-OPEC territories, development of alternative energy sources (such as coal, wind etc.) production of automobile with low fuel consumption as well as the introduction of oil consumption taxes, to discourage excessive use and lifting consumer awareness to the need to minimise oil consumption.

On increasing the quantity of manufactured goods to be purchased, almost all the OPEC members experienced the effect of this strategy as the oil boom encouraged them to embark on over-ambitious plans involving purchases of luxury goods including aeroplanes and cars as well as starting gigantic projects. However, they had no idea of the technology and had to depend on their foreign suppliers for their maintenance and the supply of the spare parts. Nigeria for example, embarked on International Telephone and Telegraph (ITT) projects, the Ajaokuta Steel complex which is still not fully completed as well as several other projects requiring foreign exchange, most of which were abandoned at various levels of completion due to lack of funds. This particular strategy therefore worked effectively and gave the industrialised nations all the necessary business advantages for their product.

The third aspect of the strategy was focussing on the weak links of OPEC's nations. Most of them suffered under this strategy. Nigeria's economy was very much dependent on oil. As it was shown earlier from the annual earning of $25 billion in 1981 the revenue earning dropped to about $7 billion in 1998.

All the strategies adopted by the OECD members therefore worked, and the industrialised nations took absolute control of the oil market as they later dictated prices of oil over a period of more than five years. Prices have maintained steady decline since then and the OPEC Countries (particularly Nigeria) are now in a dilemma as the oil market has collapsed. The advantages of strategic planning are very clear from the actions taken by OECD members. Nigeria must therefore adopt the concept of strategic planning in order to survive.

2.2.4 The Debt Problem

TABLE 2.1: Nigeria's Oil Revenue Over The Period (1981 - 1998)

YEAR	REVENUE ($)
1981	25 Billion
1986	7 Billion
1996	11 Billion
1998	7 Billion

Sources: (i) Asiodu (1994)

(ii) Budget speech (1999)

Table 2.1 indicates the revenue earned in 1981, 1986, 1996 and 1998.

As the price of the oil continued to decline at the International market, Nigeria was finding it increasingly difficult to finance its economic activities with its resources. Consequently, the country had to resort to borrowing from the International creditors to keep the economy going.

In 1978, the first external loan package of $2.8 billion was negotiated and taken by the Country. As the oil prices continue to decline, Nigeria's external loans also continued to increase such that by the year 1988 (ten years after the first loan) Nigeria was owing the sum of $31.1 billion, and $33.4 billion by 1991 (CBN Report, 1996). Thus from an oil boom and creditor nation before 1978, Nigeria turned into a heavily indebted nation by 1991. Repayment of the principal on the loan as well as the interest charges continued to mount to the extent that the country started deficit budgeting. The country continued to record this budget deficit to such an extent that by 1993 it had a budget deficit of ₦107.2 billion ($4.82 billion) or 15.4% of the GDP. This again called for a more careful and strategic approach to planning and resource allocation methods.

2.2.5 The Improvement in the Economy

The Federal Government had to put in place, serious financial and fiscal measures to bring back the economy to its proper position. Drastic measures were taken to reduce the external debt and wipe out the deficit. The measures yielded results as can be seen from Table 2.2 below:

TABLE 2.2. Nigeria's Budget Deficit/Surplus, 1993 - 1996

YEAR	DEFICIT/SURPLUS (₦)	DEFICIT/SURPLUS ($)
1993	107.2 Billion (deficit)	4.87 Billion (Deficit)
1994	81.0 Billion (deficit)	3.68 Billion (Deficit)
1995	1.0 Billion (surplus)	0.013 Billion (Surplus)
1996	37.0 Billion (surplus)	0.46 Billion (Surplus)

Source: Ani (1996), Budget Speech by the Honourable Minister of Finance of the Federal Republic of Nigeria.

As can be seen from Table 2.2, Nigeria began to record budget surpluses in 1995. Similarly, the rate of inflation in the country has been drastically reduced over the years as shown in Table 2.3

TABLE 2.3 Rate Of Inflation In The Nigerian Economy, 1980 - 1998

YEAR	INFLATION RATE
1980	9.9%
1990	7.4%
1991	13.0%
1992	44.6%
1993	57.20%
1994	57.0%
1995	72.0%
1996	28.0%
1997	8.5%
1998	9.8%

Sources: 1980 - 1995 Philips, D (1996), 1996 - 1998 BUDGET SPEECHES, by the Honourable Minister of Finance.

The new fiscal policy measures have brought down the level of inflation in the country from 72% in 1995 to 28% in 1996, and 9.8% in 1998.

Given the fluctuating nature of the revenue and the clear advantages observed in the strategic planning concept applied by OECD countries, was considered better to begin to plan for the future of Universities' capital projects.

2.3 THE NATIONAL UNIVERSITIES COMMISSION AND THE BUDGETARY ALLOCATION POLICIES

2.3.1 The National Universities Commission (NUC)

In 1945, the Government of the United Kingdom (UK) set up two Commissions to look into the future of Higher Education in its Colonies. These Commissions were:

(i) the Commission on Higher Education in the Colonies, known as Asquith Commission;

(ii) the Commission on Higher Education in West Africa known as Elliot Commission.

The reports of these two Commissions were published in 1945. One of the several outcomes of these reports was the establishment of a University College in a special relationship with the University of London which was situated in Ibadan, Nigeria. The College commenced academic activities in January, 1948.

In 1959, at the eve of Nigeria's Independence, it became necessary to take stock of what the country had or had not and to forecast what the future ought to hold in the area of development. The Federal Government of Nigeria therefore, appointed the Commission on Post Secondary and Higher Education in Nigeria, chaired by Sir Eric Ashby. The Commission submitted its report in 1960 with far reaching recommendations that were intended to guide the development of education in the country. One of the recommendations accepted by the Government was the establishment of the National Universities Commission to initiate and consider in consultation with Universities, plans for such balanced development as may be required to enable the Universities to meet national needs (Akindoyeni, 1992).

In October, 1962 therefore, the Federal Government, having realised the need to properly coordinate the University education in the country established a central coordinating body called the National Universities Commission (NUC), in line with the Ashby Commission's report on Higher Education in the country.

It started as an administrative department and later turned into a statutory body in 1974. The terms of reference given to the NUC right from the inception were among others;

(a) to advise the Head of the Federal Government, through the Minister of Education, on the creation of new Universities and other degree granting institutions in Nigeria;

(b) to prepare, after consultations with all the State Governments, the National Manpower Board and such other bodies as it considers appropriate, periodic master-plans for the balanced and co-ordinated development of Universities in Nigeria and such plans shall include:

    (i) the general programmes to be pursued by the Universities in order to ensure that they are fully adequate to national needs and objective;

    (ii) recommendation for the establishment and location of new Universities as and when considered necessary; and

    (iii) recommendations for the establishment of new faculties or postgraduate institutions in existing Universities or the approval or disapproval to the establishment of such faculties or institutions.

(c) to make such other investigations relating to higher education that the Commission may consider necessary in the national interest;

(d) to make such recommendations to the Federal Government and State Governments or to the Universities relating to higher education as the Commission may consider to be in the national interest;

(e) to inquire and advise the Federal Government on the financial needs, both recurrent and capital, of University education in Nigeria; and study the financial needs of University research and to ensure that adequate provision is made for this in the Universities;

(f) to receive block grants from the Federal Government and to allocate them to Universities in accordance with such formula as may be laid down by the Federal Executive Council.

(g) to take into account, in advising the Federal Government on University finances such grants as may be made to the Universities by State Governments and by persons and institutions in and outside Nigeria;

(h) to collate, analyse and publish information relating to University education in Nigeria, and from other sources where such information is relevant to the discharge of its functions under this Act;

(i) to undertake periodic reviews of the terms and conditions of service of personnel engaged in the University and to make recommendations thereon to the Federal Government where appropriate;

(j) to recommend to the Visitor of a university that a visitation be made to the University as and when it considers necessary;

(k) to act as the agency for channelling all external aid to the Universities in Nigeria.

As at September, 1999, the NUC Secretariat was being administered by seven Departments. These departments were:-

- Office of the Executive Secretary
- Department of Personnel Management
- Department of Finance and Supplies
- Department of Data Management
- Department of Research and Development
- Department of Academic Planning
- Department of Physical Planning and Development

The Department of Physical Planning and Development is charged with the responsibilities of coordinating and monitoring of physical development in the University system. However, effective monitoring of physical development started only in 1976 after the NUC had attained its statutory posture and after the establishment of the second generation Universities.

In order to ensure coordinated and regulated physical development, the NUC commissioned a Planning Consortium in 1978 known as the National Universities Commission Consultants of Nigeria (NUCCON) GROUP to prepare the necessary guidelines for the use of Master Planning Consultants when preparing the master plan for physical development in the Nigerian Universities.

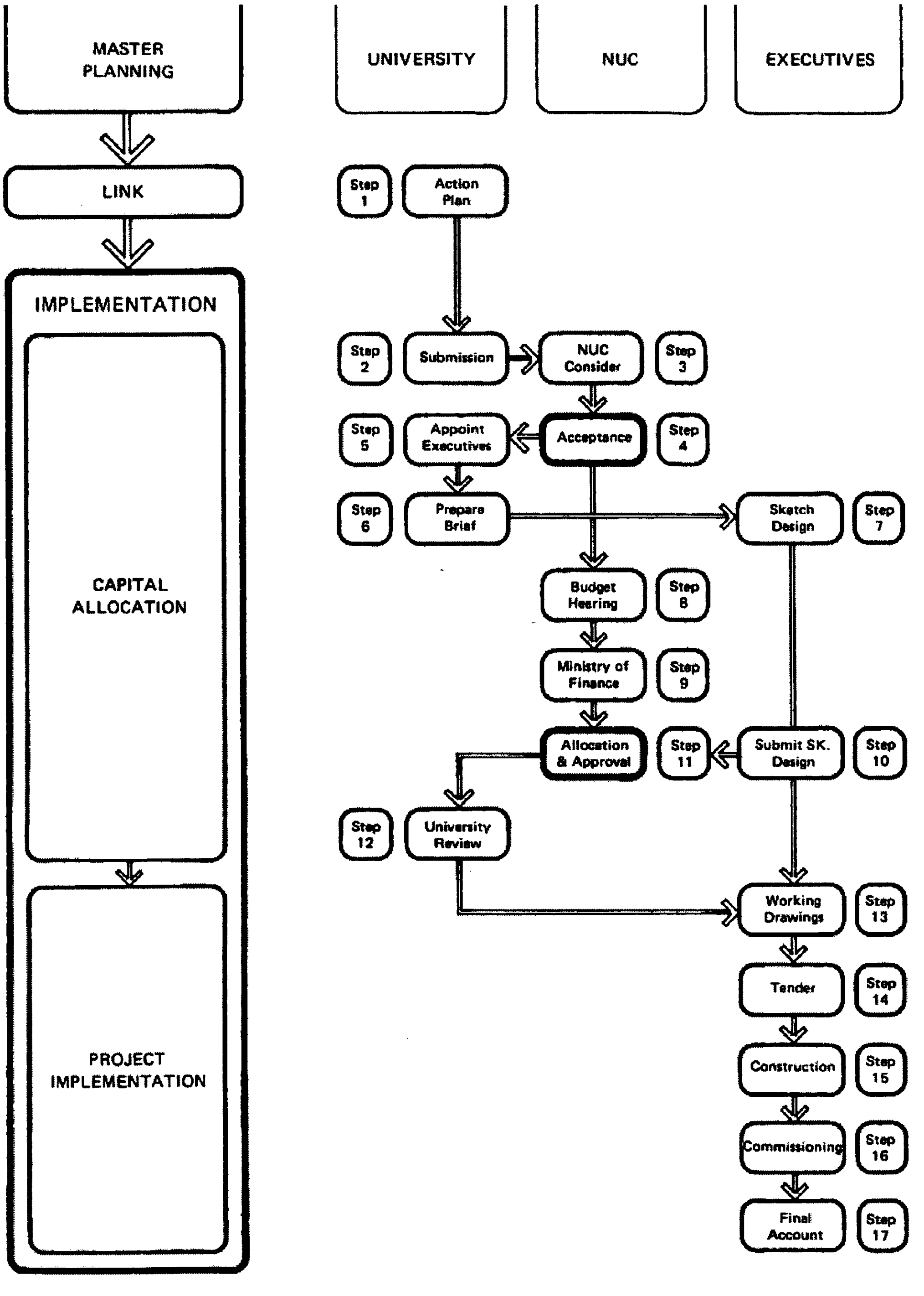
In the same year (1978), the Consortium successfully prepared and presented three comprehensive documents to guide the physical planning of Universities in the country. These documents include:

(i) **The Standards Guide: (NUCCON, 1978a, revised 1994)** This document specified the mandatory minimum standards to be used by the Universities and their Consultants in planning for building and infrastructural facilities. The standards include that of space, cost, environmental design and construction services, furniture and equipment.

(ii) **The Procedures Guide, Planning: (NUCCON, 1978b revised 1994)** This document summarises the procedures to be followed in preparing physical master plan of a University.

CHART 2.1

Capital Allocation And Project Implementation Sequence



(iii) The Implementation Guide (NUCCON, 1978c revised 1994)
This document sets out the procedure to be followed by the NUC, the Universities and the Consultants in the management of capital projects. In particular it sets out:

- The cycle of submissions to be made by each University to the NUC based on which annual capital allocations would be released. Chart 2.1 describes the process of capital allocation and implementation process. Seventeen steps were identified covering:

1. Action plan preparation
2. Initial submission of project proposal to the NUC by the University
3. NUC's consideration of the proposal
4. NUC's acceptance of the submission
5. Appointment of Executive Design Consultants by the University
6. Preparation of brief for the Consultants by the University
7. Preparation of the Sketch Design by the Consultants
8. Calling the University to a budget hearing meeting by the NUC
9. NUC prepares the Federal University system budget proposal and attend the budget defence meeting with the Federal Ministry of Finance
10. The Sketch Design submitted to the University by the Consultants and the University submits to the NUC
11. NUC approves the Sketch Design and allocates available funds
12. University reviews the Design and communicates to the Consultants
13. Working drawings and contract document, produced by the Consultants
14. Tendering process and award
15. Construction processes
16. Commissioning of the project
17. Final Account prepared by the Consultants and submitted to the University and finally to the NUC.

- The relationship of capital project programmes with the annual cycle of events in the University. The events to be carried out in each quarter of the year were:
  1. The Fiscal year begins by first of April and ends on the 31^{st} of March, the following year
  2. The Academic Teaching year begins by 2^{nd} of October and ends by 30^{th} of June, the following year
  3. The Students long vacation begins by 1^{st} July and ends 30^{th} September, each year
  4. The Fiscal year for the University system has however been changed from starting in March and ending in April each year to the present position where it begins in January and ends in December each year
  5. The implementation guide document identified the activities or project Tasks to be executed in each quarter of the year. In particular, it provides a detailed description of the annual submission covering:
     - A. Project and Cost programme chart which is a bar chart showing all the types of capital projects to be executed with their costs, locations and time period. The bar chart provides the cash flow/allocation details at a glance.
     - B. Space allocation details covering the various accommodation types. The departmental space is to be determined by the Full Time Equivalent (FTE) students in the department. The communal, social and services spaces are to be determined by the total enrolled students number. While the students and staff accommodation are to be determined by the respective population of students and staff on the campus.
     - C. Growth records of the University in terms of physical facilities covering number of faculties and their departments,

size and number of academic spaces such as classrooms, lecture theatres, communal and social service spaces as well as residential spaces.

D. Project details, showing various forms to be used in making request for on-going projects (S1), New building projects (S2/1 and S2), Existing buildings to be purchased or leased (S3/1 and S3), New Site Development projects (S4/1 and S4).

- Implementation Stage covering:
  1. The preparation of Brief
  2. Sketch design
  3. Working drawings
  4. Tendering process
  5. Construction
  6. Commissioning
  7. Final Account

Seven categories of submissions were specified during this stage involving:

(i) Request for abnormal extra cost/savings Implementation form (IM1)

(ii) Furniture/Equipment tender summary (IM2)

(iii) Building/Site Development tender report (IM3)

(iv) Building Tenders analysis (IM4)

(v) On-going projects quarterly summary (IM5)

(vi) On-going projects annual summary (IM6)

(vii) Statement of Final Account (IM7).

- Categories of Capital expenditure. The Implementation Guide specified the categories of capital expenditure that are eligible for capital grants from the NUC. These include:
  1. Acquisition of land or buildings

2. Design and construction of new buildings
3. Major restoration of Buildings
4. Alteration, change of use and commissioning of newly acquired existing buildings.
5. Design and implementation of Site Development projects
6. Design and construction of approved works outside the University boundary
7. Planning and specified surveys
8. Supply of Furniture and Equipment not part of the building contract
9. Fees and Expense.

All the existing Master plans of the Universities were therefore, prepared using the three Guide documents enumerated. From the date of their first publications in 1978, the three documents have been revised twice, the first in 1994 and the second in the first quarter of the year 2000. From the list of projects specified by the Implementation Guide to be eligible for funding, no provision was made for capital allocation to the existing building stocks in order to maintain the structures and services in a serviceable condition.

Having constructed various types of accommodation and facilities over the years, it became necessary to make such provision for capital fund allocation to maintain these buildings and their associated infrastructural facilities.

2.3.2 University Master Plan

Master Plan document:

A Master Plan is a document illustrating the intended physical facilities requirements needed to satisfy the academic intention of the University as spelt out in its academic brief. The document shows the time sequence and cost implications of the activities and therefore provides a guide to the level of funding required achieving the final objective of the plan. The Master Plan can cover a period of up to twenty-five years.

(i) Action Plan:

The action plan is a subset of the master plan. It shows the intended physical activities as dictated by the academic programmes in a short time period of three to five years. The Master Plan provides for the development of the following facilities:

- **Academic:** Faculty buildings, classrooms, lecture theatres, laboratories, workshops, library, building, etc.
- **Students:** Hostels, Common rooms, Catering facilities, etc.
- **Sporting:** Pitches, Swimming Pools, and other indoor and outdoor games facilities.
- **Administration:** Central administration and other ancillary offices
- **Infrastructure:** Roads, Electricity, Water and Telecommunication
- **Staff:** Housing Estates for both senior and junior staff.

The priority areas of development depend on the type and age of the University, the number of programmes being offered, the total students enrolment, the geographical locations of the University and above all, the capital funds made available for physical development. This is in view of the economic problems and the dwindling revenue accruing to the Government from the oil export.

The Nigerian Federal University system is structured on generations depending on the year the University was established.

2.3.3 National Economic Development Planning Process

In consultations with the Universities and guided by their action plans, the NUC prepares, periodically, development plans for the Universities in line with the provisions of the National Economic Development plan. This process started as quinquenniun (five years) plans, but in 1989, the Government adopted a policy of three-year rolling plans which allows for annual review of the plan.

All the planning documents have to be submitted to the Government for consideration and approval. So far, the rolling plan document provided the best available compendium of information on which to make policy decisions about the Government's capital expenditure outlays in the short and medium terms. The NUC appears at the Ministry of Finance to defend its proposals annually. Furthermore, the rolling plan document has to show the physical activities expected of each University on a year to year basis. Approval of this check-list of activities by the Government determines the annual budget for Universities' development.

Unfortunately, in view of the unpredictable nature of the economy as a result of fluctuation in oil prices, only certain percentage of what is usually requested is allocated by the Government. Furthermore, the percentage of capital fund allocated is rarely released in full.

Abdullahi (1999) discovered that the three year rolling plan for 1998, 1999 and 2000 made capital fund provisions of ₦5.42 Billion, ($0.064 billion) ₦6.1 Billion ($0.072 billion) and ₦7.5 Billion ($0.088 billion) respectively. The actual releases during the period however, were ₦2.5 Billion ($0.029 billion) in 1998 and ₦ 1.5 Billion ($0.018 billion) in 1999 giving a shortfall of about 54% and 75% respectively.

This situation is responsible for the under-funding of ongoing capital projects in the system. Gwomwalk (1999) stated that the level of funding of Nigerian Federal Universities has not only steadily declined in real terms; it has also become grossly inadequate for the needs of the Universities. He estimated that the Universities required about ₦50 Billion ($0.588 billion) to attend to critical areas of their needs, in 1999.

(a) National Development Plan/Rolling Plan Provisions

TABLE 2.4: Planned And Actual Public Expenditure Records Over The Development Plan Period

DEVELOPMENT PLAN	PERIOD	PLANNED EXPENDITURE (₦MILLION)	ACTUAL EXPENDITURE (₦MILLION)	SHORT-FALL (₦ MILLION)	%OF THE SHORT-FALL
1. First	1962-1968 *	1,352.3	1,073.4	278.9	20.62
2. Second	1970-1974 *	3,350.2	2,237.7	1,112.5	33.21
3. Third	1975-1980	43,313.5 ($71005.74)	29,433.9 ($48252.29)	13879.6 ($22386.45)	32.05
4. Fourth	1981-1985	42,200.0 ($58611.11)	17,340.4 ($24083.89)	24,859.6 ($34527.22)	58.9

Source: National Planning Commission, Abuja, Nigeria.

**Nigerian currency during the period, one Pound was estimated to be equivalent to Two Naira, while one Naira was also estimated to be equivalent to one Dollar.*

The effect of fluctuating oil price has had negative effects on Nigeria's capital development plan proposals.

From the first up to the fourth development plan proposals, Nigeria experienced shortfalls in all the initial allocations. The effect of these shortfalls was what necessitated the change in Planning strategy to Perspective planning and Rolling plans concept, which allow the projects to be carried forward to the next planning period.

The Action plans for all the existing Universities were prepared in the early eighties and they formed the basis for NUC's submission to the Government for the Fourth National development plan (1981-1985). The total projected estimate to Universities' development in the 4th National Economic Plan Period was ₦2.5 billion ($3.47 billion).

The Government promised a total sum of ₦1.3 Billion ($1.81 billion) only. The first two years of the plan were successful but eventually the total release to the system was only ₦0.79 billion ($1.1 billion), leaving a shortfall of ₦0.51 billion ($0.71 billion) (39.2%). This created the problem of projects being left uncompleted.

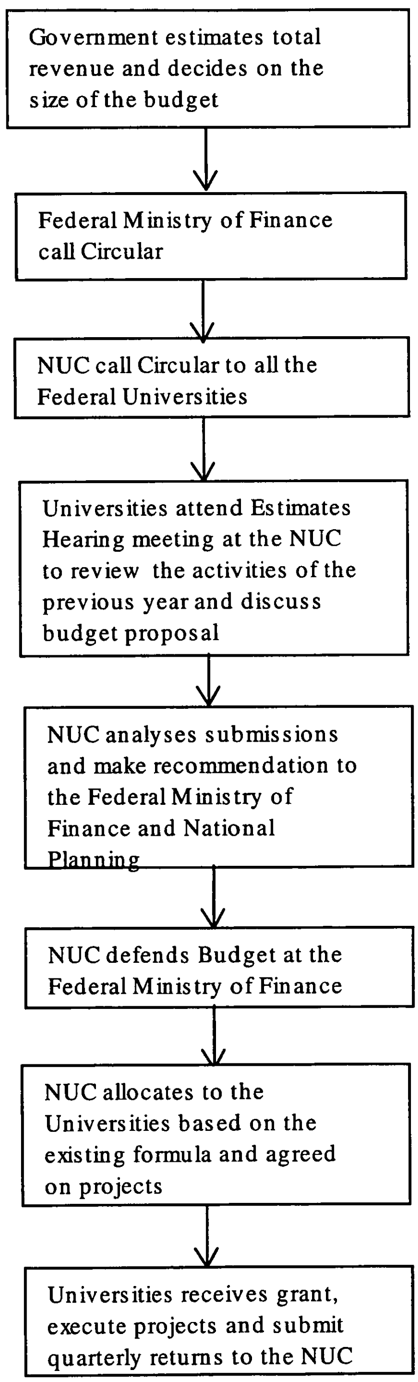
The effect of this shortfall in funding was extensive. The Universities were not able to carry out their programmes as spelt out in the Action Plans. The level of expectation of funds led to the preparation of grandiose and ambitious programmes. The dearth of funds therefore resulted in a myriad of uncompleted capital projects on the campuses. From then onwards, physical facilities became inadequate for academic programmes in existence.

(b) The Annual Capital Budget

At the beginning of each year, the Government would develop a precise conceptualisation of the direction in which it would want the economy to be steered in the coming year, and the underlying macro-economic framework on which the budget would be predicated. This included a review of performance of the economy in the previous year with regards to the stability of the Naira exchange rate against other foreign currencies, the rate of inflation, the rate of interest in the economy and above all the current price of Nigerian crude oil per barrel at the International market. After the analysis, the price of oil per barrel to be used in the preparation of Revenue estimate was agreed. The price of oil per barrel to be used for the estimate was usually lower than the prevailing price. For example, during the preparation of the 1999 Budget estimate in January, 1999, the price of Nigeria's oil at the International market was $11 per barrel. Government prepared its revenue estimate for the year 1999 using the price of $9 per barrel to arrive at its revenue projections. The approximate size of the total capital budget is normally arrived at by the subtraction of all recurrent expenditure from the projected revenue for that year. Thus, total Capital budget = Projected Revenue minus projected recurrent expenditure.

(c) Formulation of the Annual Capital Budget

CHART 2.2 Preparation of Annual Capital Budget



Formulation of the capital budget begins when a budget call Circular for the coming year is issued. Guidelines for the submission of programme proposals are spelt out in the call circular which has the forms on which details of projects to be executed in the coming year and their estimated costs are to be provided (Chart 2.2)

The size of the capital budget is usually smaller than that of the recurrent budget. This means that there must be savings in recurrent costs for any money to be available for capital expenditure, since one can only invest what one saves. The capital budget is therefore a programme for investing what as a nation we have saved.

In order to avoid plan distortions, the programmes approved by the National Planning Ministry for execution in the first year of the Rolling Plan are those normally used as reference during the bilateral discussions, and projects are not normally funded if they have not been admitted into the Rolling Plan.

(d) NUC Call Circular to the Universities and the Universities Annual Budget Procedures

As soon as the Government's general call circular is received, the NUC invites the Universities to present their Rolling Plan Proposals for the next three year period and the capital estimate for the following year. Each University would first of all estimate its projected students enrolment for the coming year using the approved growth rate for its generation. The total space requirement of the new students and other supporting facilities are estimated using the space standard per FTE student as provided in the Standard Guide (NUCCON 1978a), using the current cost/square metre, the total estimated project cost is arrived at. In this way, the estimated cost of all the necessary projects to be executed that year is established for the budget proposal. The annual budgetary exercise in the Universities is generally hectic. It starts from the Departments to Faculty Development

Committees, Faculty Boards, University Development Committees, Senate and finally to Council.

After the Council's approval, the Rolling Plan and Estimates are then forwarded to the NUC. At the NUC, the Universities' estimates proposals are thoroughly scrutinized by people who are specially trained for the job. They have University background and are therefore knowledgeable about University procedures. They apply methods which have been tested over decades and have been fully accepted. They apply criteria which are well laid down, such as cost and space standards for academic, teaching support, communal and other social buildings. Staff/Student ratios for various disciplines are also applied. Growth rates for each generation and many other indices peculiar to the University system are also part of the assessment criteria adopted for the exercise (NUCCON, 1978, a, b, c).

When the analysis is completed, the NUC invites each University on a particular date fixed for it to appear and defend the Estimates. This is an annual event for each University.

The proposals are thoroughly discussed with each University during the long and rigorous Estimate Hearing. The Universities' proposals are in most cases subjected to drastic cuts by the NUC, using the policy guidelines as announced by the Government.

After the hearings with the Universities, the NUC prepares its recommendations to the Government. This is then defended at the Ministry of Finance.

(e) Government's Annual Allocation of Capital Grants

At the beginning of each year, Government announces its allocation for capital projects that year based on the available funds. The NUC would in turn receive its block grant allocation for the entire University system and using the accepted allocation formula propose the distribution to the Universities and present to Government for approval.

After the approval, the Universities would be informed and advised as the funds become available and these are normally released on a quarterly basis.

2.3.4 The Current Method of Capital Fund Allocation To The Universities by the NUC

Basically, the Universities and other Institutions under the NUC, apart from the National Universities Secretariat, are grouped into five distinct categories known as generations. Each Institution within a category receives the same amount of capital fund annually under the current method. Over the years however, peculiar physical problems are found to characterise institutions belonging to the same generation. Some of the problems in each of the generation include:

(i) Inter University Centres:

Like the Universities, there is the need to upgrade the facilities for their academic and residential activities. Presently, the facilities on ground are inadequate and despite the current students' population, no 'take-off' grant was allocated to any of these Institutions

(ii) Fourth Generation:

The University of Abuja located within the Federal Capital City is still operating within the Mini Campus. The academic and infrastructural facilities, apart from being inadequate, for the University's population, are grossly below the standard required for a University campus. The University would therefore need to:

- Open up its permanent site and commence development, provide basic infrastructure (Water, Roads, Electricity, Telecommunication, etc.)
- Provide basic academic facilities
- Provide staff and students facilities.

All these would require substantial sums of money in addition to maintaining the facilities at the mini-campus.

(iii) Third Generation Universities:

Some of these Universities are operating on two campuses at the moment. They need to develop their permanent sites fully to facilitate optimal utilization of facilities now available. FUT Minna started several structures on its permanent site but has been unable to complete them due to the exhaustion of a special presidential grant. Both FUT, Owerri and ATBU, Bauchi need to provide additional academic/infrastructural facilities as well as staff and student accommodation on their permanent sites to enable them optimally utilize the sites. FUT, Akure and FUT, Yola are yet to commence the development of their permanent sites.

(iv) Second Generation Universities:

These Universities were established during the oil boom era. Most of them started big projects that could not be completed before the economic crash of the early 1980s. These Universities therefore have uncompleted projects that need to be completed to ameliorate the critical infrastructure and space shortfall. The University of Jos started a Library Complex in 1981, which has now been converted into a multi use facility for academic purpose after completion. Other suspended projects such as the Faculty building for Education and Environmental Sciences need to be resuscitated. Bayero University Kano has a Library Complex with the first phase at 90% completion which needs to be completed to provide space for academic use. University of Calabar is yet to adequately rehabilitate its facilities at Okuku Campus, which was taken over from University of Cross River State for purposes of the Faculty of Agriculture, and to complete the Definitive Arts and Definitive Library buildings which are at various completion stages. The University of Maiduguri needs to complete its Library complex due to the inadequacy of the existing Library facilities. The University of Port Harcourt needs to complete the Library which was started in 1984 but never completed, while its College of Health Sciences was destroyed by fire in September, 1994 and needs to be rehabilitated. The Nnamdi Azikiwe University, Awka requires substantial fund for its change of status from non-residential to residential. The University of Uyo is operating on its mini campus and has just commenced the development of her permanent site and would require substantial funds for its development.

(iv) First Generation Universities:

The critical problems here have to do with the fast deterioration of existing facilities due to age and lack of adequate maintenance as a result of inadequate funds. The University of Nigeria, Nsukka has an uncompleted Library Complex, which was started in 1981, while its academic and residential buildings need rehabilitation. Ahmadu Bello University, Zaria, has a large number of both academic and residential buildings in various stages of deterioration. Almost all academic facilities at the University of Ibadan have attained the total dilapidation status. Apart from the deterioration of facilities at OAU, Ile-Ife, its Central Administration building is yet to be completed.

The peculiarity of each University calls for special consideration to be given in allocating capital funds according to needs instead of the uniform approach currently being practiced.

2.3.5 SUMMARY OF CHAPTER TWO

Having reviewed the various processes through which the Government plans, budgets and executes capital projects in Nigerian Universities, it can be concluded that the planning, negotiating and budgeting system for physical development are robust, well developed, clear and distinct.

Over the years, large number of physical facilities were created in the Federal Universities. The effect of low level of funding in view of the general shortfalls in the revenue expected from the historically oil dependent economy, suffering from constant price fluctuation, makes it extremely difficult to maintain them. It is common to see large number of academic facilities in the form of Lecture Theatres, Classrooms, Laboratories and Libraries completely dilapidated and subsequently abandoned for lack of funds to carry out routine maintenance. Major maintenance problems in the Universities include leaking roofs as a result of climatic conditions within the location of the Universities and age of the structures; blockages of toilets and frequent breakdown of sanitary fittings as a result of over stretching their use; problems of water supply in the system and electrical problems and the breakdown of Laboratory equipment; large portions of unmotorable roads as a result of pot-holes and many other problems associated with the finishes. The poor construction methods as well as the use of low quality materials contribute to the high-level of dilapidated facilities on the universities campuses. As the situation is at the moment, the Universities are in a state of confusion as they are neither able to provide new spaces nor able to maintain the existing ones due to insufficient funds. Unfortunately, the annual capital budget and approval for projects to be executed are not based, as far as can be seen, on any perceived inventory of existing capital formation (due to absence of such data); hence, one observes an array of capital waste in the field in the form of completed but unused structures and infrastructures (Akindoyeni, 1999).

CHAPTER THREE

3.0 A THEORETICAL FRAMEWORK FOR THE STUDY

3.1 PREAMBLE

Higher Education the World over is facing the greatest challenge of expansion in enrolment within the boom-bust cyclic nature of the World economy. On the eve of the 21st Century, there is an unprecedented demand for and a great diversification in higher education, as well as an increased awareness of its vital importance for socio-cultural and economic development. The second half of this Century will go down in the history of higher education as the period of its rapid expansion in Student enrolments, Worldwide. The enrolment rose from 13 million Students in 1960 to 82 million in 1995 (UNESCO, 1998). It is also the period which has seen the gap between industrially developed, the developing Countries, and in particular the least developed Countries with regard to access and resources for higher learning and research. The UNESCO World Conference on Higher Education (1998) identified fundamental problems of higher education system world wide in general and that of Africa in particular. The African problems include amongst others :-

I. Coping with surging numbers of students in the face of declining budgets;
II. Excessively high student/teacher ratio, which makes individual attention to learners difficult;
III. Undue attention to municipal and social services, which reduces funds available for teaching and research;
IV. Deterioration of infrastructure, due to lack of maintenance;
V. Imbalance in students enrolments between Science and Technology based programmes and the Humanities;
VI. Insufficient attention to, and insufficient resources for research;
VII. Lack of long term vision in the planning and management of teaching and research activities.

The need to develop new guidelines which would focus on key issues such as relevance, quality, management/finances and co-operation is now imperative. Higher educational institutions would have to adopt forward-looking management practices which respond to the needs of the environment, as specified in their missions.

Resources classifications in the Nigerian higher education system cover the following items:

a) Staffing
b) Accommodation
c) Equipment
d) Infrastructure
e) Books and Journals
f) Funding

All these items of resources are dependent on the level of available funds. Funding has therefore become the crucial factor in resource consideration (Akindoyeni, 1992).

Much of the reported research work on resource allocation appear to have focussed on mechanisms of inter organisational resource allocation and the effects they have on the behaviour of recipients. The "block" funding mechanism, for example, is a non interventionist method, allowing institutions the freedom to decide for themselves. The "bureaucratic" approach to funding is an interventionist method by which the government as allocator decides for the recipients by designated funding and by regulations. The market oriented is a mechanism which is not only non interventionist; it accepts that those who directly consume the benefits of the services ought to provide the resources, with the implication that the values of the consumers should decide the activities of the service producers (Clark et-al, 1992).

The nature of these dynamic tensions between allocator-governments and recipient-institutions are such that in every country there will always be a search for more satisfactory ways to allocate resources to, and within, institutions. Moreover each new way will have its own impact on the organizational behaviour of recipients. The interest by some governments is in a new mechanism, one which could be said to include elements of the three approaches, mentioned earlier.

This Chapter reviews the theories on organisational and policy change as they relate to various mechanisms being operated in different countries, and also relates them to the current practice in Nigeria. It reviews the various developmental strategies adopted by Nigeria since inception and examines the budgetary provisions to the Education sector as compared with the recommended provisions in other Countries.

The Chapter provides a comprehensive comparison of procurement systems within the University systems in United Kingdom and Nigeria. The chapter provides a comprehensive literature review and a theoretical framework for the study.

3.2 RESOURCE ALLOCATION NETWORKS AND BUDGETARY PROVISIONS FOR THE EDUCATION SECTOR IN NIGERIA

3.2.1 Government Policies and Organisational Change in Nigerian Higher Education

Policy-oriented research publications are relatively uncommon in Nigerian higher education system, mostly due to relatively low level of research funding in the area. The European Commission on the other hand, instituted a targeted framework of research programme known as the Targeted Socio-Economic Research (TSER) programme, which is aimed at providing funds for selected priority areas of research. The Commission through TSER provided funding for a research which examined organisational changes in higher education in eight European Countries including Austria, Belgium (Flanders), Finland, Great Britain (England), Italy, the Netherlands, Norway and Portugal. The research focussed attention on how the higher education organisations (Universities and Colleges) respond to change in government policies and programmes. The research investigated how governmental policies and programmes affected the economic policies and programmes of the Universities and Colleges in the eight Countries.

Two theoretical perspectives on organisational change were analysed and applied. These theoretical perspectives include:-

i. Resource dependency perspective; and

ii Neo-institutional perspective.

In conducting the research, Gornitzka (1999) reviewed several works (including Pfeffer and Salancik 1978; Pfeffer, 1982, HEINE, 1998), and found concensus among Social Scientist to the effect that an organisation does not and cannot exist in a vacuum but has to interact with its environment for achieving its basic objectives. He states that the interaction implies that organisations to an extent are dependent on their environment for what is called critical resources. These critical resources included raw materials, personnel, monetary resources (funds) and so on. Both the resource dependency and the neo-institutional perspectives share these two assumptions.

Organisational choice and action are limited by various external pressure and demands, and the organisations must be responsive in order to survive.

(a) **Resource dependency theory**

Resource dependency theory perceives organisations as reactive; if a change in the environment threatens critical resource relationships an organisation will make adjustments in order to arrive at an equilibrium that guarantees a continuous flow of critical resources. Changing the resource flows and how they are structured will then bring about organisational change. This implies that environmental transformation induces organisational change (Gornitzka 1999 P.7).

In a similar view, a resource dependency perspective argues that organisations are other-directed, constantly struggling for autonomy and discretion, faced with constraints and external control. It introduces concepts and arguments that allow it to rely heavily on a political view of inter and intra-organisational interaction. It emphasises that organisation act strategically and make active choices to manage their dependency on those parts of their task environment that control vital resources (HEINE, 1998). The resource dependency approach implies that an organisation's responses to external demands can be predicted to some extent from the position of resource dependencies, confronting it. However, Gornitzka (1999) argued that there are several factors that sever a deterministic and automatic link between an organisation's resource dependencies and its actions. His major argument includes:-

i. Organisations are usually in a position of inter-dependencies; the focal organisation also controls resources that other organisations need. The potential for one organisation influencing another derives from its discretionary control over resources needed by the other and the other's dependence on the resources and lack of countervailing resources and access to alternative sources.
ii. Organisations can have other options apart from complying with external demands. They can manipulate and manage their dependencies in several ways.
iii. Environments are not treated as 'objective realities", but became known through the process of enactment. There are different criteria for assessing organisational performance and the demands made will not always be consistent.

To understand organisational change therefore, it is necessary to examine the way organisations perceive their environments, how they act to control and avoid dependencies, the role of organisational leadership in these processes, as well as the way internal power distribution affect and are affected by external dependencies (Gornitzka, 1999 P.8).

(b) **Neo-institutional theory**

The institutional perspective approach views organisations to be operating in an environment dominated by rules, requirements, understanding and taken-for-granted assumptions about what constitute appropriate or acceptable organisational forms of behaviour (Scott 1987; Oliver 1997). This perspective argues that adoption of policies or programmes is determined by the extents to which the measure is institutionalised, whether by law or by gradual legitimisation. The focus is on how organisations adopt to norms and beliefs in their environments and not to resources. The variation is what differentiates it with a resource dependency perspective approach. Oliver (1997) contended that in the institutional theory, firms make normatively rational choices that are shaped by the social context of the firm, whereas the resource-based view suggests that firms make economically rational choices that are shaped by the economic context of the firm.

The neo-institutional perspectives holds that for organisations to change as a result of government initiatives there has to be a normative match or congruency between the values and the beliefs underlying a proposed programme or policy and the identity and traditions of the organisation.

(c) **Characteristics of policy process and content**

Gornitzka (1999, P.5) defined policy as a public statement of objective and the instruments that will be used to achieve it.

Policies are therefore either objects of political choice or that of legislative choice, i.e government policies linked to a decision in elected assembly at the State or National level and have a parliamentary approval. Alternatively, it could be linked to a Decree signed into law in a Military administration. In a perfect parliamentary chain of command, an elected legislature makes a policy decision, whereas an administrative agency of government executes them.

Higher educational institutions are considered as organisations that attempt to "manage" their environment for their interest of survival, growth and certainty. Policy making and policy change were studied in the TSER research on higher education and the theoretical framework agrees with the resource dependency and neo-institutional perspective found in organisational change concepts. The resource dependency approach views policy change as a result of new bargain structure between policy-making actors when resources are redistributed. In this perspective, policy formation is viewed as strategic goal-directed behaviour and problem solving under conditions of conflicting interests. An institutional perspective on the other hand would see policy change as driven by rules as well as taken-for-granted assumptions about appropriate behaviour. It would focus on how policy processes attempt to attract the values and beliefs about the nature of higher education and knowledge production and its role in the society (Bleiklie et-al, 1995).

The TSER research on higher education also identified the characteristics of policy contents to include:-

a. Policy problems, which define the societal problem that a policy is designed to correct.
b. Policy objectives, which define the direction of achievement. Such direction could be aimed at changing, adjusting or maintaining behaviour of target organisations or groups. This provides a basis to classify the policy as being innovative or maintenance of policy, with the latter having standard operating procedures whereas the former takes on the shape of an

experiment. Policy-objective characteristics also identify the type of change being aimed at, i.e. is the policy aimed at a system of higher education, as whole or at separate institutions. The TSER research work proposed that the more a policy departs from the existing behaviour and procedures the more resistance it will encounter when implemented and the more it will be attracted by the tendency to transform a reform back towards the established order. The research work further draws conclusions from earlier study on higher education conducted in Europe and stated that adjustment policies and 'familiar' policy measures can be handled by organisations standard operating procedures for change and in that sense, they are much more likely to be sucessfully implemented (Gornitzka 1999 P. 18).

c. Normative basis of a policy, which explains the values and beliefs on which the policies and programmes are based.

d. Policy instruments, which explain how and by what means the government pressures to conform to policy and programmes are to be exerted. This include, Modality (information), Treasure (money); Authority (legal, official power); and organisation. A given policy instrument can draw on two or more of these capabilities simultaneously. The research concluded that it is hard to think of how the tool of organisation can be an instrument without some kind of money or funding attached to it (Gornitzka, 1999 P.20). Funding or finance is therefore the most important instrument an organisation requires for operation. It was discovered that the role government initiatives play in organisational change processes in higher education is significantly influenced by the overall dependencies within which organisations in higher education find themselves. A critical finding which is fairly consistent in the study of implementations is the importance of making sure that there are some kind of organisational arrangements buffering policy implementation against short term fluctuations. (Gornitzka, 1999 P.21).

e. Policy linkage, which gives a measure of the extent to which the content of policy is breaking with or continuing the content of other government policies. More often, Universities and Colleges find themselves in a situation of conflicting requirements from different types of government policies and programmes.

(d) **Structure of Nigerian Higher Education System**

The Nigerian higher education system is a three-tier system comprising

i. The University Sub-System,

ii. The Polytechnic Sub-System and

iii. The Colleges of Education Sub-System.

As at November 1999, the University Sub-System comprised forty-four institutions, of which thirty were Federal institutions, eleven State owned institutions and three were privately owned institutions (Jibril, 1999). The University Sub-System was coordinated and supervised by a Federal Government Agency called the National Universities Commission (NUC).

The Polytechnic Sub-System comprised forty-nine institutions of which seventeen were Federal institutions, while twenty-seven were State owned institutions and five were privately owned (Tijjani, 1999). The Sub-System was coordinated and supervised by the National Board for Technical Education (NBTE).

The Colleges of Education Sub-System had a total of sixty-three Colleges. Sixty of the Colleges were publicly owned while three only were privately owned (Ishaku, 1999). The Sub-System was coordinated and supervised by the National Commission for Colleges of Education (NCCE).

In terms of student enrolment, the University system had a total enrolment of 400,000 students in 1997/98 session.

There is standing NUC policy, which allocates 60% of students' admission to Science-based studies and 40% to Arts-based. Few universities were able to achieve this ratio in 1997/98 sessions. This is one of the problems that requires definite policy enforcement to ensure that the university system achieves the desired objectives.

The Nigerian situation is such that Government policies relating to University development and maintenance are formulated and passed into law by the Federal Government. All the policies formulated are then passed on to the Universities for implementation through the National Universities Commission (NUC) which was empowered by law to ensure that all the Universities (Federal, State and Privately owned) comply with the policies.

The NUC therefore proposes policies relating to the administration of the University system and advises Government to approve. By its functions, NUC was in a special position to influence policy changes as well as organisational changes in the higher education system, based on the policy implementation strategies adopted.

Using the mechanism of fund allocation formula, the NUC can change the flow of funds going to the Universities if only to enable universities to comply with the policy guidelines relating to the release of the funds. The Universities would have to comply with the NUC's requirements, since the body controls their funds, which is one of the critical resources they require to operate. This phenomenon therefore supports the resource dependency theoretical viewpoint for both organisational and policy changes. Furthermore, the NUC's instrument of enforcing accreditation and other regulations will make the Universities react to any demand for change in policy and organisational arrangement. This again supports the neo-institutional theoretical perspectives earlier reviewed.

The Federal Government through the NUC has the overall responsibility of formulating and approving new policies aimed at changing the method of operation in the University System. From time to time, therefore, Government sponsors research programmes aimed at improving the performance of the system to enable it meet current standards. This study, on the development of a new funding model, is one of such programmes. The Government intends to use the outcome to approve a new funding formula for allocating capital grants to the Universities, which has never been looked into since the allocation by the year of establishment known as the "generation model" was introduced in the early 1980's.

3.2.2 The Concept of Resource Allocation in the Nigerian Higher Education System

Resources for higher education in Nigeria were identified to include; Accommodation, Equipment, Infrastructure, Books and Journals as well as funds. All the items are however dependent upon available funds for running the institutions.

Resource allocation in the higher education sector is the process of deploying available human, materials and other means among the sector's teaching, research, and community service activities. The significance of the allocation problems is that if resources are limited, an increased assignment of activity can be made only at the expense of one or more activities, which compete for the resources. The tighter the limits on available resources, the more evident and pointed this interdependence among activities become and the more critical the allocation problem becomes (Clark, et-al , 1992 P.1464).

In the latter part of the twentieth century the earlier good flows of resources for higher education have reduced substantially. Governments in most countries have both reduced their support of the system and increased their demands on it.

In Nigeria for example, the Federal Government funded the university system for an equivalent of $697per Student (unit cost) in 1991 but in 1998, the same Government funded the system for an equivalent of $362 per Student (unit cost). This was only at 36.2% of the World Bank recommended unit cost of $1,000 per student for Sub-Saharan Africa (Jibril, 1999). Ironically, the total students enrolment in the Nigerian University System in 1991 was about 180,000 students whereas that of 1998 was about 400,000 students. The unit cost of $1,000 recommended is much lower than the 1985 cost for the developed countries. William (1991) for example, reported that the average recurrent expenditure per Full Time Equivalent (FTE) student in the USA for 1984/85 session was (i) $11,200 in private universities and (ii) $7,001 in public universities. This was against US $10,258 in Japan's public universities and $5,212 in the private universities in 1985. Enrolment pattern in the US for the 1984/85 session was 9.0 million students out of which 6.7 million (75%) were in public institutions.

Ekong (1999) warned against the damage to academic vitality of the University System as a result of the Subsidy Cuts, unless timely actions are taken to respond appropriately.

Some countries have experimented with profiling and use of performance indicators in their approach toward allocating resources. This has forced a strengthening of the management structures and allocation practices in higher educational institutions, with consequent impacts on their organisational behaviours.

A profile is a statement of an individual institutions goals and its current planned teaching, research and service programmes (Clark et-al, 1992). Indicators are used to report the health of each programme in terms of the efficiency which resources are used, the effectiveness of achievement of programme-goals and the responsiveness to institutional and governmental priorities. Indicators such as the staff/student ratio, the number of professors in relation with other senior and junior academics, the budgetary provisions for books, journals and other goods in relation with the provisions for salaries and personnel allowances as well as the number of graduates produced within a period are some of the common performance indicators used for the comparison. The United Kingdom (UK) and Australia are among the Countries practising the profiling model.

To allocate resources therefore, is to assign available means to achieve desired purposes. The means include human effort and skills, together with supplies of goods and the services of durable goods such as buildings and equipment. An allocation problem arises when the means available cannot produce sufficient of the products required to achieve all the desired purposes. The more pressing the purposes and the scarcer the means, the more acute the problem of allocation becomes. The more acute the problem, the more earnest the attempts to devise efficient solutions become.

According to the economic approach, an efficient system is one, which enables given outputs to be met at the lowest possible levels of inputs or cost (Clark et-al 1992 P.1465). Economists seek to achieve efficiency by allocating resources "rationally," that is, by ranking purposes to be achieved, evaluating alternative allocations, then identifying which of these achieves the most valued objectives. Rational economic analysis is said to be more readily accepted when two conditions are satisfied: when goals are unambiguous, ranked, and provide clear criteria for output valuation, and when there are known, consistent variations between changes in the mix of resources and consequent changes in outputs.

Policy analysts have studied the structures and procedures of resource allocation and identified their impacts on the achievement of particular productive purposes. The approach of such policy analysts is generally to address complex allocation situations where goals are vague and disputed, where considerable uncertainty exists about the consequences of particular allocations, and where there is a fluid cast of policy actors. These analysts typically investigate how organisational values and practices affect the resulting pattern of resource allocation (Gorditzka 1999). Recommendations arising from their investigations frequently aim to modify the structural and procedural arrangements to achieve desired purposes in ways consistent with these values. Clark, et-al (1992 P. 1465) described an efficient process from a policy analyst's viewpoint as that which commands institutional confidence and is quick, decisive, comprehensive, and mutually consistent.

Reviewing various studies on resource allocation problems, Sou-sen et-al (1999) classified attempts to solving resource allocation problems into three distinct categories. These include; Time cost trade off, Resource-constrained allocation, and unlimited resource levelling. Resource Constrained allocation is more relevant to higher education as the system is unlikely to have unlimited resources at any particular time. Furthermore, the method tends to support the theoretical perspective of resource dependency approach to organisational and policy change.

Higher education is an enterprise in which purposes are multiple and where there are constantly changing casts of actors at all decision-making levels. Moreover these actors are usually out to protect, and if possible enhance, the academic interests they represent. Rational analysis is therefore important as it provides a basis for evaluating outcomes, which result from the use of allocated resources. Institutional administrators frequently employ rational analyses to legitimise their bids to acquire resources by assuring resource providers that maximum benefits can be expected from the use of the resources they provide. In these ways, rational analysis is itself a tool used in the processes of resource acquisition and allocation.

3.2.3 Organizational Levels of Allocation

The origin and nature of the resources to be allocated are often of central consideration in how they are to be allocated. In any public higher education system, there are series of levels through which resources are allocated; society, government (which itself could include federal, state and local governments and their agencies), institutions, and departments. Those who make allocations at each level seek to ensure that the resources they provide are used to pursue their purposes in the most effective and efficient manner. Unless the grantors are confident that the recipients share their own values and purposes, they will want to influence where and how the recipients deploy their granted resources and will require accountability of their usage. On the other hand, recipients generally want to be free to decide where and how they allocate their received resources and not to have to account to any outside body. This is especially so in universities where there is a strong tradition of institutional autonomy.

Higher education is a resource-intensive sector of society. Teaching and research are not only highly labour-intensive but the labour utilized is among society's most skilled and creative. Moreover, the community's expectations of the sector (e.g., concerning its ability to teach and graduate all who qualify to enrol) typically exceed its achievements (Ndayako Report, 1997). In the developing countries, government is the sole provider of resources for higher education especially in Nigeria, where it provides more than 90% of recurrent and 100% of capital grants.

3.2.4 Government allocation within Higher Education

Governments, the World over, are faced with two important allocation questions. These include **how** should resources be allocated, and **where** (i.e. to which institution) should they allocate? (Howlett and Ramesh,1995, Hall,1993). The most important of the two is how should the allocation be made. This is because the way resources are allocated can affect the effectiveness and efficiency of what will be done. Therefore, getting the allocation mechanism right is fundamentally more important, and indeed politically more contentious, than accurately determining the correct amounts to be allocated among the institutions. Frackmann (1988) contended that in a state-financed higher education system, the most determining question might be how and by whom the allocation of funds to the institution and inside the institutions is made. General Abdulsalami Abubakar (1998) while inaugurating the Board of Trustees for the Education Tax Fund in Nigeria, remarked; "It is indeed sad that on the eve of the 21st Century, our Educational System is in dire need of funding and facilities."

Various governments, particularly those in developing nations are in a dilemma, trying to devise the most effective and appropriate method of funding higher educational institutions. At the heart of this dilemma is a tension, on one side, the policy makers want to ensure that their own goals are pursued efficiently and effectively by those institutions receiving grants from government revenue, while on the other side, they rarely have the knowledge, the time or even the inclination to appreciate the complexities of institutional organisation or the values held by the academic community (Clark et-al 1992). This situation therefore, challenges policy-researchers to help policy-makers in devising funding techniques which will both provide the necessary resources to institutions and induce voluntary behaviour consistent with the purposes of the granting authorities. It is indeed this kind of challenge that motivated this researcher to find parameters which would eventually be used to develop an equitable funding model that will be acceptable to the Government and the Universities in Nigeria.

Various research were conducted on policy implementation which provide a theoretical background on the application of policy implementation ideas in education (Williams, 1987; Gornitzka, 1999). It was pointed out that a financing mechanism is both a means of allocating resources so that learning may occur, and a channel for messages between providers and users of finance. Williams

(1987) argued that the mechanism by which institutions receive their finance affects the power relations and the styles of allocational decision making within them. Williams followed the ideas of Adams Smith to identify three mechanisms of external funding to educational institutions. These include:

I. Endowment or block grant,
II. Bureaucratic; and
III. Market oriented.

In the block grant model, the institution can determine its own allocational priorities, (Salter and Tapper 1994); and in the bureaucratic model, the external funding agency establishes the regulatory mechanisms to assure itself that the public interest is being met. The role of the institutions is to implement whatever political objectives are on the higher education policy agenda (Gornitzka, 1999 P.24) while in the market model, academic institutions effectively sell services to many sources of finance so that no single external agency can control its internal activities. The market model assumes that all State actions and activities by public bodies will be less efficient, effective or just than activities of private individuals relating through the market (Miller and Edwards, 1995)

Since the establishment of the National Universities Commission (NUC) in 1962, the mechanisms of funding the Federal Universities in Nigeria have been a hybrid of the first two models (i.e. the block grant and the bureaucratic). The Federal Government allocates block grant to the NUC for allocation to the Federal Universities. The NUC in turns uses the bureaucratic model to allocate the funds to the various institutions. However, the process of using the bureaucratic model for allocation to various institutions has been the main target of sharp criticisms by various interested-groups. The market model, on the other hand is yet to be acceptable within the Federal University system in Nigeria

3.2.5 Market Model

On the theoretical level, Van Vught (1988) evaluated the market model and argued that all higher education, institutions seek to find a market "niche" in which they hope to survive. Those institutions whose leaders read the market correctly and establish themselves in their own niches will survive and prosper, while those which do not or fail to respond when market changes remove their niche, will wither.

Analysing Van Vught's model, Clark et-al (1992) argued that the market model would seem most applicable in a densely populated country with a "lassez-faire" government and a great number of and variety of single-purpose institutions. The focus was on the United States as it was remarked that "apart from the United States, it is difficult to envisage such a country". However, the analytical description of Van Vught's model would seem likely to be applicable to the Nigerian nation in the near future with the recent establishment of three universities of Agriculture by the Federal Government.

Many Researchers (Karmel 1987; Miller and Edward 1995) commented on the market model with greater emphasis being paid on exploring the conditions under which it is likely to work and the likely impact on the internal operations of individual institutions.

Karmel (1987) analysed the market model in greater detail and ultimately rejected it. He contended that any proposal to move towards the market, or any other model, must be assessed carefully. Each proposed scheme must be spelt out in detail and its consequences assessed dispassionately. He argued that there may be better ways of achieving efficiency through, for example, internal institutional reforms, than through the introduction of the market solution.

This view is particularly valid in the case of the Nigerian Federal Universities where the introduction of market solutions to generating more funds is already severely affecting the quality and standard of the University graduates and the consequent dilution and diversions away from the Universities main objectives of teaching, research and community service. Clear examples are the new wave of Nigerian Universities opening and operating "out-reach centres" in far away location from their main area of operation, in attempt to provide part-time degree programmes to working class people of both private and public sectors at a fee higher than that allowed under their normal operations. This situation encouraged University of Ibadan, the Obafemi Awolowo University and the University of Lagos to open "out-reach centres" in Kaduna and Abuja, far away from their main locations. The same holds for the Abubakar Tafawa Balewa University of Technology, Bauchi to have opened a Centre in Kaduna, Abuja and even at Warri. Similarly, the University of Calabar, has an outreach centre in Lagos and many other Universities in its generation. Many of these Institutions do not have sufficient qualified personnel to teach the subjects being offered to the students at the outreach centres, even on their main campuses, but rely heavily on part-time lecturers from the private and public sectors, whose academic credentials remain highly questionable. The resulting effect was that the quality and standard of graduates have fallen drastically (Ndayako Report,1997).

It is with this situation in mind that this current research on the development of funding model supports the institutional reforms concept whereby acceptable performance indicators will be developed which are to be mutually agreed for use to arrive at an acceptable and equitable funding level for each institution from the available resource to guarantee the maintenance of standard instead of the use of market model.

3.2.6 The Block Grant Model

In the block grant model, resources are provided as untied block grants from public or private sources, permitting the recipient institution to decide on its own deployment within the terms of its mandate. This model is therefore, consistent with the concept of institutional autonomy so enshrined in our Universities. Researchers have shown that this model has been widely in use in the United Kingdom and English-speaking countries. Kogan (1988), Trow (1988) and Clark et-al (1992) believed that the Universities in the United Kingdom and in former British dependencies (including Nigeria) have until recently enjoyed high degrees of autonomy in virtually every aspect of their functions. Similarly, Frackmann (1988) and Salter and Tapper (1994) described the block funding model as still providing an ideal allocation process, as it provides institutions with the opportunity to regulate themselves. In support of these research findings, Nigeria, being one of the former British colonies, is operating the block grant model in funding its Federal Universities through the NUC. Government gives the block grant to the NUC for allocation to various Federal institutions in the system and the NUC is to determine the priority areas in accordance with the terms of reference given to it by the Government. The NUC is still enjoying these advantages of block grant model.

3.2.7 Government Allocations: A New Approach

In the second half of the 1980s many governments began to experiment with a novel approach to allocating resources to their higher education institutions. The new approach heralds an important change in government-institutional relationships.

Using the Williams (1987) models, government approaches to funding higher education institutions have been typified as either block or bureaucratic, with the main differences between the two being the conditions attached to funding, and the regulatory mechanisms for monitoring adherence to the set conditions. It was observed that those countries following English tradition have tended to employ the block funding model, while many others, such as those on the continent of Europe, have typically used the bureaucratic approach. Both models conceived that the essential task is to provide resources to institutions; differences occur in the type and degree of accountability (Goedegebuure et-al,1994).

There is however a change in the Governments' position towards the institutions. The change represents a shift in governments' perception of what they are doing. Rather than seeing themselves as providers of resources, governments are beginning to see themselves as purchasers of products, for which they are prepared to pay. In effect, governments are preferring to adopt the role of consumers of higher education services.

Instead of resources being designated for specific function, each agency is budgeted bulk funds over which there are only a few broad financial controls. Agency mangers are thus allowed considerable flexibility in working arrangements and freedom of decision making. Control is by product accountability. Central decision-makers clearly define the organisational goals and the more detailed objective of the programmes and sub-programmes for which their agencies are responsible. At the end of each accounting period agency managers are required to demonstrate the extent to which their programme objectives have been met. For this purpose each agency negotiates with central decision-makers a limited set of appropriate indicators of performance.

This new approach to funding appears to have been adopted both by those governments, which had been using the block grants approach, and those, which had followed the bureaucratic approach. It is believed that the same movement towards governments seeing themselves as consumers of higher educational services has been interpreted in the former countries as a movement toward greater central control, and in the latter, as decentralisation of government control over institutions (Clark et-al 1992 P.1471). A more common approach to allocating resources within higher education is now emerging in view of the acceptance of a new basis for conceiving how resources should be allocated among institutions (Miller and Edward, 1995).

The Government of the United Kingdom has decided to move into single grant provisions for funding its higher educational institutions through the Higher Education Funding Council as from the1st of April, 1996. Under the new arrangement the Funding Councils received single block grant for recurrent and capital instead of the previous arrangement where separate totals were announced for recurrent and capital funding (SHEFC, 1995a).

The mechanism of profiling and its attendant instrument, performance indicators, will play important roles in this new approach to government resource allocation within the higher education sector. A profile is a statement of an individual institution's goals and its current and planned teaching, research, and service programs. Indicators are used to report the health of each programme in terms of the efficiency with which resources are used, the effectiveness of achievement of programme goals, and the responsiveness to institutions and governmental priorities (SHEFC 1995 b).

Beneath the increasing application of profiles and indicators is the fact that governments are increasing their pressures on higher education institutions to become more flexible and responsive to changing economic and social needs and to pay more attention to the outcomes of their work.

3.2.8 Review of National Development Strategies

Nigeria embarked on Development Planning strategies as far back as 1946, long before independence in 1960. Development Planning can be defined as the effort of government to map out the key objectives and strategies for the optimum use of the limited available resources for the achievement of developmental objectives.

The first Development Planning effort started with the Ten Year Development Plan (1946 - 1955) which was drawn up by the Colonial Administration. This plan was aborted in 1951 to give way to the 1951-55 Development Plan which was based on the Report of the World Bank Mission to Nigeria in 1951. This Plan was succeeded by the 1955-60 Development Plan which gave due cognisance to the establishment of the three Regions and the Federal Capital Territory in Lagos. Under this Plan, education ranked 5th in priority, judging from the magnitude of financial resources allocated to it. The sectorial allocation was 10.3% of the gross public sector investment of ₦1.4 billion (Uyanga, 1996). Although these pre-colonial plans might have recorded some achievements, they were not based on clearly identified national objectives and priorities. They may therefore not be regarded as true national plans (NPC, 1996).

In 1962 - 1968, the government came up with a new development plan which for the first time had common goals for all the regions in the federation. It was based on an articulated national account with a capital expenditure budget of ₦2.2 billion. The plan came with a ray of hope for education. But this was soon shattered by the political upheavals which led to the Nigeria's Civil-War, from 1966 to 1970.

The next development plan, 1970-75 was based on a budget of ₦3.192 billion, out of which ₦77.8 million, i.e. 13.5% of the total budget was allocated to education (3rd National Development Plan, 1975). The plan took into consideration the need for rehabilitation and reconstruction of the nation after the civil war. Emphasis was laid on integrating the sub-sectors in the plan with a view to improving the standard of living of all Nigerians. To this end, five national objectives were formulated which comprised:

(i) the development of a strong and self reliant nation;

(ii) the building of a great and dynamic economy;

(iii) the building of a democratic society;

(iv) the building of an egalitarian society; and

(v) the provision of equal opportunities to all Nigerians.

In response to these, there was increased enrolment in primary schools from 3.5 million in 1970 to 4.5 million in 1973. A similar trend was noticed in the secondary schools. Eight new Federal Colleges, four Colleges of Education and three Schools of Arts and Science were established in various states of the Federation. A 70% growth was also observed in university enrolment.

The crises that later developed in the educational system had their roots in the developments in the school system in the early 70s particularly in increased students enrolment and the development in tertiary education. Education was seen as a national right, hence the participation rate shot up tremendously in the states, calling for the building of new schools and the expansion of existing ones.

With the oil boom of the 1970s, the 1975-80 development plan witnessed more financial input (₦ 30 billion) ($49.18 billion).

This plan made the greatest impact on the goals of increasing the educational opportunities of Nigerians. It was during this plan period that the 1976 Universal Primary Education (UPE) was launched. But unfortunately, the plan witnessed the following shortfalls.

Oil prices fell lower than estimated barely five months after launching the plan, leading to a downward trend of the economy, and a consequential borrowing from foreign banks. This posed a significant problem in education as anticipated monies were never received. Furthermore, there came the political crises when in April, 1975, soon after the plan was launched by General Gowon, General Murtala Mohammed took over power in July, barely four months after. Principal actors in the system were either transferred, retired, dismissed, or impeached as a cabinet reshuffle followed the political instability. This led to a review of the plan.

The 1980-85 development plan, and the 1990-92 rolling plan had similar characteristics as their predecessors. They attempted to corroborate the tenets of preceding development plans with even greater emphasis on education hence the slogan, "education for all by the year 2,000."

Most of the infrastructural facilities created by the Plan provisions such as highways, educational institutions and public utilities are in a state of disrepair as it would appear that various facilities were expanded beyond the capacity that could be effectively managed. The rate of inflation reached an all time peak of 72.0% in 1995 but has progressively reduced to about 9.8% in 1998 (Budget Speech, 1999).

Since the attainment of independence therefore, our major problem has not been the inability to draw up well articulated strategies, programmes and policies as contained in the series of five-year Development plans and Rolling plans, but rather our capability in successfully implementing the plan.

3.2.9 Planning for the Education Sector and Budgetary Allocation

The National Policy on Education (NPE) document gives a high level of government commitment to the pursuit of the goals of the policy. It says;

> "Education in Nigeria is no more a private enterprise, but a huge government venture that has witnessed a progressive evolution of Government's complete and dynamic intervention and active participation. The Federal Government of Nigeria has adopted education as an instrument per excellence for national development."

Unfortunately, Government's action over the years as it relates to financial allocations to the education sector, fell far below the expectations of the sector in general, and the institutions in particular. In recognition of the fact that Education is an expensive social service and requires adequate financial provision, both the Federal and various State Governments have continued to allocate the "Lion's share" of their annual budgets to education. It was however, observed that despite the seemingly high allocation to the sector, it is still behind most other developing nations.

The Federal Government's allocations to the Education sector in 1997, 1998 and 1999 were 11.53%, 10.94% and 9.7% of the annual budget respectively.

In 1998 however, the allocation to Education sector in Ghana was 18% of its budget while that of South Africa was 22% in the same year. The UNESCO's stipulation of 26% of the country's annual budget to be given to education is therefore far from being achieved in Nigeria.

Investment in human capital was also observed to be the least in Nigeria between 1960-1989 giving an annual average of $1.8 per Capita Education expenditure when compared with Ghana's $11.1 among the seven developing countries considered. (Adewole, 1999)

The impact of the planning mistakes and the developmental problems in the Nigerian Federal University System has far reaching consequences.

During the third national development plan period 1975-80, seven new Universities were established in 1975 as against the NUC's recommendation of five Universities. The new Universities created were located at Calabar, Jos, Ilorin, Kano, Maiduguri, Port Harcourt and Sokoto. Each of the new second generation Universities was planned for 10,000 students at ultimate and was therefore allocated a minimum of 10,000 hectares of land area to develop. The land areas in most of the cases were located far away from the cities and the places had no basic infrastructure such as Roads, Water, Electricity or

Telecommunication facilities. The Universities were expected to provide all these in addition to their required buildings. Foreign Consultants were commissioned to prepare a master plan for each of the new Universities and the six existing ones. Well-articulated plans were developed covering a period of 15 to 20 years of full implementations, with five year action plans to mark the phase development. The total cost of the master plans when fully implemented averaged about ₦350 million, which was, then over $500 million for each of the Universities (as ₦1.0 was approximately $1.5).

New Vice Chancellors were appointed for the Universities and each of them appointed Consultants to design the projects listed on their master plans. Instead of ensuring that the projects in the action plans to be in line with the phased development, the Vice Chancellors were competing amongst themselves as who will have the biggest or the tallest high rise structure on his campus. Consultants were therefore commissioned to design all the projects on the Master plan of the University.

The Consultants were given a free hand to design anything they like, consequently, they competed amongst themselves as to who will produce the most grandiose designs. The slogan at that time was that "the bigger the better". The Vice Chancellors and their Councils went on awarding contracts at every sitting. The Vice Chancellors' common desire at that time was to complete all the projects listed on the Master plan of his/her University within the first term period of 4 years, without taking cognisance of the amount of capital grant given to the second generation Universities of an average of ₦10.0 million, about $15.0 million (Ekong, 1994). Projects that were planned to start at different phases of the University's development were awarded at the same time and construction activities commenced. Most of these projects remained uncompleted up to 1999 with classical examples at the University of Calabar.

In the same way, the Civilian Government was encouraged by the oil revenue of the 1980 to establish another set of seven new third generation Universities of specialist nature in 1980. They were known as Universities of Technology and were located in Abeokuta, Akure, Bauchi, Makurdi, Minna, Owerri and Yola. The planned development was for 5,000 students each at ultimate. However, the implementation of their plans was handled the same way as those of the second generation.

Many projects were started and were at various levels of completion when the prices of oil dropped in 1983 and economic recession set in. The Universities' campuses therefore became centres of abandoned projects at various stages of completion. The abandoned projects at the permanent campus of Federal University of Technology, Minna are typical examples.

The boom in construction activities was not limited to the Universities' campuses alone as new and gigantic Teaching Hospital complexes were started in all the Universities that had medical schools. Most of these projects remain uncompleted to date and therefore become the monument of unplanned expenditure in the Country. This therefore, justifies the need to re-appraise the situation and to adopt the concept of strategic planning.

3.3 PROCUREMENT PROCESSES IN THE UNIVERSITY SYSTEMS AT THE UNITED KINGDOM AND NIGERIA

In 1995, the Government in the United Kingdom (UK) requested Sir Robin Ibbs to look into ways of controlling expenditure in major capital projects in the public sector of Britain. Sir Robin made far-reaching recommendations and outlined steps to be taken to assure that projects are completed on time and within the approved cost. The report laid emphasis on careful planning and tight project management to be undertaken by individuals carrying personal responsibilities for delivery of the required results. Based on the recommendations, the Scottish Education Department (SED) drew up detailed guidelines covering such areas, as, the responsibilities for initiating and managing projects in Higher Education Institutions in Scotland. Other part of the UK developed similar documents. The guidelines were published in the form of Building Procedure Notes which were distributed to all the institutions being supervised by the Department and the use of them was made compulsory for any project funded through the Department (SED, 1987). A review of the process was done in 1994 (Latham Report, 1994) and necessary amendments were effected. The use of these guidelines resulted in high degree of success to be recorded in the execution of capital projects in the UK University System.

With the commencement of the European Community Common market, procurement directives for purchases whose value exceeds £149,728 for supplies and services as well as value of £3,743,202 (equivalent to five million EUC) for contracts (UAD PM,1995). The directive stipulates the procedures and processes of tendering. The directives stipulated that tenders should be awarded based on 'lowest price' or "most economically advantageous tender". For all university projects, tenders are to be appraised by the Consultants, who would recommend to the University Court for award in conjunction with the SHEFC. Finally, the name of the successful Contractor must be published in the official journal of the EC and all other Tenderers should be informed.

The comparative review of the Nigerian Systems was facilitated by the review of related literature on issues affecting the Nigerian Construction industry and Contractors Aniekwu (1995) identified the major problems to include high levels of dependence on imported materials and spare parts as well as the issues of incompetent and unqualified Contractors winning the major contracts. Abdullahi (1996), discovered that despite the volume of scholarly works on the Nigerian Construction Industry, very little published literature was available on the direct effects of research findings on the projects in Nigerian Universities. The paper reviewed procurement methods in the Nigerian University System and discovered that the tendering procedures are similar to those being used in the UK University System, except that even though Nigeria belongs to the Economic Community of West African States (ECOWAS), the Nigerian University System and indeed the construction industry in Nigeria are not bound by any procurement directive common to the member countries. With the participating Contractors coming from Nigeria alone, the level of competitiveness and ultimately the greater advantages of experience from other countries are missing in the Nigerian System. The criteria for selecting Contractors are found to be similar to that of the UK. Unfortunately, a Contractor in Nigeria behaves typical of his counterpart in any developing country where they are considered to be dishonest businessmen who provide poor quality works, delay the completion of works and try to maximise profit at all cost. In their attempts to win contract at all cost, the Nigerian Contractor can provide the best information during tendering which might not necessarily be a true reflection of their actual record.

The Nigerian University System was found to be the only public body that appears not to have any limit in terms of contract award. The University Governing Councils award contracts in their universities without getting further approval from higher authorities of Government. This was discovered to be one of the reasons why universities award contracts and start projects at the same time without regard to available resources, most of which end up abandoned.

In terms of construction policy, the Federal Government of Nigeria launched a National Construction Policy in 1991 with the aim of boosting the productivity of the construction sector. The recommendations have been fully implemented in the University Systems.

3.3.1 Standard Document and Procedures for Construction Procurement

The United Kingdom (UK) in general and the Scotland in particular have a central co-ordinating body known as the Higher Education Funding Council (HEFC) which is a body set to regulate and coordinate the activities of all the Higher Educational Institutions in the country. The body allocates funds for both recurrent and capital expenditures and also supervises the expenditure of the grants, using specific guidelines.

For capital expenditure, the guidelines are in the form of building procedure notes, which are revised from time to time. The procedure notes sets standards and rules, which must be followed by any institution proposing to execute a project using the public fund. Standards have been established for space and cost limits and submissions to the council by the Universities in respect of ongoing and new projects are usually done using standard forms as follows:-

1. Statement of Need; Form SN; This gives the need to be met.
2. Submission for new project at project definition stage:- Form PD
3. Readiness to Tender: Form RT
4. Tender Acceptance:- Form TA
5. Progress Report:- Form PR
6. Project Completion:- Form PC
7. Final Account:- Form FA
8. Post Project Evaluation:- Form PE
9. Payment of Capital Grant:- Form CG

These are for ongoing projects and new acquisitions. Claims for grants of building works should normally be supported by an Architect's certificate (SHEFC) (SHEFC, 1995).

Throughout the project execution, the Funding Council remain very strict and emphasise careful planning, cost control and approval at each particular stage.

No University is allowed to move to the next stage without getting written approval from the Council. The council also emphasise on strict adherence to the established cost limit for the project. Once approval has been given for a cost limit to a project, no University is allowed to change it without written consent of the Funding Council. The strict cost control and approval strategies adopted are some of the reasons why projects are started and completed in the UK universities without being abandoned at any stage (SHEFC, 1995b).

Comparison of the standard documents and procedure used in project execution in the Nigerian University system, through the National Universities Commission, a coordinating body similar to the Higher Education Funding Council revealed that Nigeria has a well established and good system, suitably designed to take care of peculiar nature of the environment. (NUCCON document 1978 a, b and c, revised 1994)

There are three standard documents used for the execution of projects. These include:-

1. Standard Guide; which sets space standard, furniture and equipment, environmental conditions, as well as cost limits;
2. Planning Guide; which sets all the necessary procedures for preparation of a Master plan for a University.
3. Implementation Guide, which sets all the procedures and stages for project implementation and approval.

The stages, implementation and monitoring strategies specified for realising a project in these documents are similar to those being used in the UK. The standard documents being used in Nigeria are in many cases richer as they reflect the local condition. A detailed comparison is summarised in table 3.1.

TABLE 3.1 Comparison of Building Procurement Procedures Between the University System in the UK and Nigeria

PROCEDURE	SCOTTISH HIGHER EDUCATION FUNDING COUNCIL (SHEFC)	NATIONAL UNIVERSITIES COMMISSION (NUC)
1. Approval stages for new project	Seven stages on different forms	Seven stages using different Forms
2. Method of fund releases for the project	Monthly and strictly on Architect's Certificate	Regular quarterly release without Architects, Cert.
3. Approvals Process	Written Approval must be obtained before proceeding on the next stage	No Strict compliance of stage by stage written approval
4. Comparison of approved cost limit of the project	Done at every stage of the project and once the limit is exceeded, the project has to be re-designed	No strict checks and projects exceed their cost limited even before the award
5. University Contribution to the total project cost	Up to 50% in some Projects	No contribution in most projects
6. Funding Profile	Checked at every stage	No check is done
7. Freezing of Brief	At the end of stage (iv), outline proposal stage brief must be frozen	Brief remain open up to tender stage
8. Option Appraisal	Consultants must submit option appraisals of Maintenance Cost between alternative designs	No appraisal for maintenance cost is done at the design stage
9. Appointment Consultants	Done in consultation with SHEFC	Done independently by each University
10. Appointment of Project Managers as a separate Consultant *	Compulsory for every project over £1.0m in value (One million pound sterling)	No Project Manager is appointed
11. Appointment of Project Director/Controller/Chairman for all the project on the campus	Compulsory and the person report to the Secretary of Governing Board	Task Force Team appointed and report to the Vice Chancellor
12. Contract prices and completion period	All contracts for a period of two (2) years must be on fixed prices	One (1) year contract to be on fixed price but not being adhered to due to the high inflation rate
13. European Community * (EC)Regulation	On all contracts over £3.3m	Not applicable
14. Post Project Evaluation and Feedback	Done immediately a project is completed	Universities don't make early submissions
15. List of Contractors to bid for a project	To be approved by SHEFC	NUC not involved in approving the list
16. Tenders exceeding cost limits	Must be approved by SHEFC before the award	Universities award their contracts irrespective of the cost limit.
17. Detailed site investigation	Must be done at stage 2 (Project definition)	Not normally done during design. Stage and become the major variation, later
18. Monitoring of projects *	Not necessary for project below £1.0m	Done on all projects Irrespective of the cost

* **£1.0 ≅ $1.5**

Sources: (i) Scottish Higher Education Funding Council (SHEFC)

(ii) National Universities Commission (NUC)

From the detailed review and comparison conducted in 1996, it was observed that the Nigerian University system has acquired standard procurement processes comparable with any other University in the developed countries.

The findings support the observation made by the Longe Commission Report on Higher Education which stated;

> "The Commission observed that Nigerian Universities had established standards comparable to the best in other parts of the World" (Longe Commission Report, 1992).

The lapse in the Nigerian University system is the non-adherence to the standards set which is causing a lot of problems that must be addressed.

3.3.2 Effects of Deviation From Standards

From the review conducted, the major factors affecting the successful completion and realisation of a project in the Nigerian University system have been traced to non-compliance with the set standards and lack of proper financial and cost planning.

The objectives of cost planning are to control the cost of a project, as the design develops to produce a cost effective solution and to obtain a tender within a predetermined cost limit. Cost planning is therefore that part of cost control which is applied during the design stages of a building project. It reduces delays in the planning and design stages, makes an important contribution to the achievement of programmed starting dates, financial targets, and the stability of programmes as a whole.

The standards set for project planning and implementation emphasised the establishment and maintenance of a cost limit for a new project. Once established, the cost limit is supposed to be maintained up to the completion of that project. Any action that would be taken during the design and implementation stages must be to maintain the cost limit at its initial value. The effects of deviation from the standard and the cost limit are enormous and can easily lead to non-completion of the project.

Some of the effects of such deviations on cost limits in the Nigerian University system include:

- Freezing the brief at stage iv (outline proposal and scheme design stage). On completion of this stage, the brief are supposed to be frozen and no alterations should be considered. Unfortunately the Nigerian University system clients are not too sure of their requirements at the initial stages and new briefs are passed on to the Consultants even at tender negotiation stage. Consequently, the cost limit keeps on changing to a higher value. The introduction of Computer Networking facilities at the new National Mathematical Centre (NMC) administration block during tender negotiation with the successful Contractors was a typical example in 1997.
- Lack of firmness and frequent changes in the briefs by the clients during design stages.
- Refusal to comply with planning guidelines to carry out soil investigation for the specific location chosen to site a project before the end of its design. Here the case of Faculty of Agriculture at the Federal University of Technology (FUT) Minna, is a good example. The sub-structure of the project doubled the value of its initial cost limit in 1996.
- Inexperience of the Consultants and lack of proper coordination between the Architect and other Consultants. These factors cause incompatible elements and components to be designed and insufficient provision for inflation to be made by the different Consultants, the effects of which are only realised by the main Contractor on site. This usually results in significant changes on the original cost limit.
- General attitude of public office holders towards selecting Contractors and contract award. This affects both the cost limit and ultimate realisation of the project.

3.3.3 Summary of Selected Interviews with Senior Officials

A total of nine organised interviews were held in Scotland with the Researcher and one Supervisor in attendance. Four of the meetings were external (outside the UAD) while five were internal (within the UAD). Comprehensive Agenda was prepared for each meeting and proper minutes were produced by the Researcher at the end. The summary of these discussions is presented below:

A. **External Interviews**

(i) St. Andrews University - 12th January, 1996

(ii) Scottish Higher Education Funding Council (SHEFC) - 9th January, 1996

(iii) National Health Services (NHS) Headquarters - 13th December, 1995

(iv) Common Services Agency - 24th November, 1995

(a) St. Andrews University

St Andrews University was selected for the visit being one of the oldest Universities not only in Scotland but in the United Kingdom as a whole. It was the first of the three Colleges established in Scotland and located at St. Andrews, Glasgow and Aberdeen. St. Andrews College was founded in 1411, Glasgow College in 1451 and Aberdeen in 1495, they were all given recognition as Universities.

A meeting was held with the University's Secretary during the visit and the discussion centred on:

1. **Estates and Equipment**

The team was informed that the University had a total of 170 buildings valued at about 200 million ($300 million). It had a total students enrolment of about 5,500 students out of which 70% were fully accommodated.

2. **General Maintenance Policy**

The University had a well established long term planned maintenance policy of 7 years rolling plan being reviewed every six months. The University maintains it s structures adequately, including the Student Hostels which are self financing and sometimes used as commercial Hotel accommodation when the students are on vacation.

3. **Capital Projects Execution**

The University has an Estate strategy based on which it draws its capital programmes. It has a well-established capital base with substantial amount of funds in its reserve as at the time of the meeting.

4. **Private Finance Initiative (PFI)**

The Private Finance Initiative Scheme is an arrangement where private developers undertake to provide specific projects to an institution for a particular purpose. The institution in turn pays for the services being provided by the project on a regular basis. The new policy directive from the UK Government was that Institutions planning to start a new project must show evidence of PFI before public funds can be allocated into the project. The PFI is meant to transfer the risks of financing the project, construction and managing it to the private sector. The meeting discussed the concept extensively and concluded that it would appear to work better for students accommodation and other commercial projects.

(b) Meeting with Scottish Higher Education Funding Council

Discussions during the meeting centred around:

1. **An Overview**

This traced the historical developments on Estates and Equipment grants, poor maintenance culture and the change in attitude regarding physical facilities. The freedom given to the Institutions to manage capital project under £1.0 million without further monitoring from the Funding Council was also discussed.

2. **Corporate Plan Objectives**

The 1995-98 corporate strategic plan for the SHEFC was fully discussed.

3. **Promotion of Good Practice**

The concept of Estate Strategy was extensively discussed where the team was informed that the concept started in 1993 after a report was submitted to the Council on Capital Funding and Estate Management in Higher Education in the UK. A circular was sent to all the Institutions in January 1993 asking them to prepare an Estate Strategy for their organisation and submit to the Council on or before December 1993, as a condition for receiving capital grant the following year. From the 21 Institutions funded then, 18 submitted within the deadline while two submitted in January 1994, and the last one much later.

SHEFC does not need to approve the document for it to be implemented, but the document was being used by the Council as a source of information for determining the total physical and financial requirements over the period covered. In the Nigerian situation, a similar document serves as a master plan.

4. **Options appraisals**

Each Institution was requested to look into various options of solving a particular problem relating to physical development including zero option or do nothing, in order to arrive at the best solution to a problem.

5. **Appointment of Project Manager**

As a policy directive, Institutions must appoint a Project Manager for any project over £1.0 million ($1.5 million) in contract value. The Project Manager must be an independent person separate from the team of Consultants on the project and not a member of staff from the Institution.

6. **Monitoring of Project**

Capital funds for projects over £1.0 million ($1.5 million) were released on actual demand based on Architect's certificates and was paid as the work progresses. Extensive monitoring was carried out and each Project Manager was expected to prepare and submit a written report quarterly to the Institution that employs him and the report will later be sent to the Council.

7. **Planned Maintenance**

The Council laid a lot of emphasis on planned maintenance and as at the time of the meeting a procedure guide was being prepared on the issue.

8. **Allocation of Capital Grants**

Allocation of Capital grants for estate and Equipment was formula driven up to about 75% of the total grants. The formula was based on transparent factors including total Student enrolment and emphasis was placed on science subjects.

9. **Private Finance Initiative (PFI)**

The Council emphasized the new approach for funding capital projects through the PFI.

(c) Meeting with Scottish Office of National Health Services

National Health Services in the UK receives more capital allocation from the

Government than the University system each year. For 1996 for instance, the NHS was given £200.0 million ($300 million) for its capital expenditure while the total allocation for Estate development for the University system through the SHEFC for the same year, was only £69.6 million ($104.4 million) (about 35%). The NHS has therefore set up a very good system of monitoring capital projects and a well established planned maintenance policy.

Discussion during the meeting centred around:

1. **Monitoring Strategy**

   A condition survey was conducted for all the Hospitals in 1980 and the data was held centrally on a network at the NHS Head Office. The buildings were graded from A-D depending on their physical condition at the time of the exercise. Updating was carried out at regular intervals and the data was improved. The meeting was informed that it took 15 years for the system to develop to the level seen at the time of the visit. Even then a lot of improvement was required as details regarding a particular building in a specific location could not be called immediately from the screen.

2. **Method of Funding New Projects**

   The concept of private finance initiative also applies to the NHS and all projects must show the PFI component before any public funds could be applied.

(d) Meeting with Common Services Agencies (CSA)

The common services Agency acted as the Consultants on all the National Health Services projects in Britain. They established standards and monitored the capital projects in UK. As at the time of the meeting, the Agency was winding up as a result of the introduction of the private finance initiative of funding capital projects.

The meeting therefore acted as a forum for exchanging professional ideas on effective planning and cost control of capital projects. A set of the standard documents used for planning, option appraisals and cost control was given to the research team.

(e) Internal Interviews

The Internal interviews held were as follows:

(A) Monday 20 November 1995: - The Deputy Finance Officer, Mr King, on financial matters generally.

(B) Tuesday 21 November 1995: - Mr John Black, Head of Maintenance in the University, on general policy of the University regarding maintenance.

(C) Tuesday 28 November 1995: - The Procurement Officer, Mrs Mary Kirkpatrick on the procurement policy of the University and the implication of European Economic Community (EEC) Treaty.

(D) Monday 18 December 1995: - Mr John Black on issues related to the new Library and the policy of appointing a Project Manager.

(E) Meeting on Space Utilisation in University of Abertay, Dundee.
A meeting was held on Tuesday 19 December 1995 with Dr David Button, Head of Modular Scheme and the Officer in charge of teaching space allocation and time tabling for the University.

Discussion centred on general academic space utilisation, using computerised timetable. The University as at the time of the meeting, was using CEL CAT 4 for windows software. The University was able to achieve academic space utilisation of between 85-90%.

(The details on the external and internal interviews are shown in appendix I)

The comparative study revealed that even though the Nigerian University system has acquired standards equivalent to the best in any developed country, the Universities have many abandoned and suspended projects, dilapidated buildings as well as other infrastructural facilities, all resulting from poor planning and lack of foresight. Discussions during the interviews in particular have helped the development of questionnaires for data collection from the Nigerian Universities. The data collection centred around information relating to available spaces, the physical condition of the existing facilities, the age of the facilities and the maintenance record on them. The decision to conduct a general condition survey of the building facilities in Nigerian Universities was arrived at after the discussions. Overall, the study helped in identifying the need to build a new information system for capital projects in the Nigerian University system.

3.3.4 Summary of Chapter three

(a) Higher Education all over the World is facing the great challenges of expansion in enrolment with a compressed education budget. The enrolment rose from 13 million students in 1960 to 82 million students in 1995. (UNESCO, 1999)

The resource classification in the Nigerian Higher Education cover the items such as staffing, accommodation, equipment, infrastructure, books and journal as well as funding. Of all the resource items, funding was discovered to be the most crucial factor.

(b) Two theoretical perspectives relating to policy and organisational change were found to be applicable in Nigerian Higher education. These are Resource dependency perspective and Neo-institutional perspectives. Resource dependency perspective perceives organisations as being reactive to a change in the environment which tends to threatens critical resource relationships. The organisation is expected to make adjustments in order to arrive at an equilibrium which will guarantee a continuous flow of the critical resources. Changing the resource flows and how they are structured will bring about organisational change. In support of this theoretical perspective, it was discovered that by changing the method of allocating funds to the Nigerian Universities, the Government, through the National Universities Commission (NUC) can bring about organisational change in the University system. Similarly, it was concluded that the potential for one organisation to influence another is derived from its discretionary control over resources needed by the other and the other's dependence on the resources and lack of countervailing resources and access to alternative sources. Since all the Universities depend on the Government finances through the NUC, the NUC has the influencing factor over the institutions. The Neo-institutional theory on the other hand, views organisations as being operating in an environment dominated by rules, requirements, understanding and assumptions. This perspective holds the view that organisational change is brought about by law or gradual legitimisation. Since the NUC ensures the compliance of Government laws, it was concluded that the organisation (NUC) was in a position to bring about changes in the Universities.

(c) Resource allocation in Higher Education sector is the process of deploying available human, materials and other means among the sector's teaching research and community service.

The significance of the allocation problems is that if resources are limited, an increased assignment to an activity can be made only at the expense of one or more activities which compete for the resources.

In the later part of the twentieth century, the good flows of resources for higher education reduced substantially. Governments in most countries, reduced their support of the system and increased their demand on it. Nigeria funded its system for an equivalent of US $697 per student in 1991 but in 1998, the same Government reduced its funding level to only $362 per student. In contrast, the World Bank prescribed an optimum cost of $1,000 per student per annum.

Governments all over the World are faced with some important allocation questions which include: how should resources be allocated and where should they be allocated. The financing mechanism is both a means of allocating resources so that learning may occur, and a channel for messages between providers and users of finance. The mechanisms by which institutions receive their finance affects the power relations and the styles of allocational decision making within them. Three types of external funding mechanisms were found. These include; The Block grant or endowment where an institution receives the grant in bulk and decides its priorities, the Bureaucratic, where the institution receives the grant with conditions attached and the market oriented where the institutions operate and generate funds according to the services provided. The review of literature revealed that both the block grant and the bureaucratic methods were in use in the Nigerian system while a move towards the market oriented method was being considered. The Conclusion was that the block grant method had worked well for the National Universities Commission (NUC) and the entire University system.

(d) Government budgetary allocation to the Education Sector in Nigeria was estimated at 11.53% in 1997, 9.4% in 1998 and 9.7% in 1999 (of the total annual budget) in the country.

This figures were rather low compared with the UNESCO recommended figure of 26% of the country's annual budget (Adewole, 1999).

(e) In 1985, the United Kingdom Government requested Sir Robin Ibbs to look into ways of controlling expenditure in the major capital projects in that country. A comprehensive report was submitted which laid emphasis on careful planning and tight project management. Using the report, the Scottish Education Department (SED) then, prepared comprehensive procedure guidelines for executing capital projects in the University system in the United Kingdom. The guidelines cover such areas as the responsibilities for initiating and managing projects in Higher Education Institutions. A review of the Robin's report was done by the Latham report in 1994.

Comparison of the Nigerian University system with that of the United Kingdom revealed that three standard documents were prepared and were currently in use for the execution of capital projects.

The documents were Standard Guides, Procedure Guide (Planning) and the Implementation Guide. Comprehensive comparison of the procedures for executing capital projects in the United Kingdom and Nigerian University system indicated that the Nigerian University system had acquired standard similar to the best University in any part of the World. The problem was found to be that of implementation. The findings supported earlier report presented to the Federal Government on Universities, (notably, the Longe Report, 1991), the Ndayako Report, 1997).

The conclusion drawn was that the procurement process in the Nigerian University system was comparable with that of any University in the developed countries.

CHAPTER FOUR

4.0 STRATEGIC PLANNING AND THE CONCEPT OF COST MODELLING

4.1 Preamble

The need for additional resources, particularly financial provisions, in the Federal University system are unending, but because resources are always limited, the matter of establishing priorities in allocation process must be addressed.

Decisions made on allocation of resources usually determine institutional or system direction during the years to come. In order to make responsible decisions about resource allocation, there must be a sound base of information available to the decision makers. The integration of the planning and budgeting processes provides the necessary linkage, among environmental factors, institutional priorities and resource allocation.

Strategic Planning is an analytical approach that encompasses an assessment of the future (usually five to ten years ahead), the determination of desired goals in the context of the future, the development of alternative courses of action to achieve those goals and the selection of courses of action from among those alternatives (Norman, 1983, Fielden, 1994)

This chapter highlights the theoretical view-points of strategic planning and examines the modelling concept as it applies to a new information system for effective planning.

4.2 The Concept of Strategic Planning

Strategic planning focuses attention on the major issues confronting the institution and on the effective deployment of institutional resources to address those issues. It involves the application of a total systems approach to management. With this approach, the decision-making parts of an organization's mechanism are better coordinated.

Right from the inception of the first University in Nigeria, the system witnessed tremendous changes. Multi-campus systems evolved, enrolment grew rapidly, decay in the infrastructural facilities sets in, funding from Government dwindles, and the rate of change accelerated, making the future more uncertain and requiring more effective preparation of capital expenditure plans. Forecasting of expenditure within three to five years as well as other environmental factors became essential. Strategic Planning is therefore expected among others, to enable the Universities to stay on course and ensure maximum utilization of resources in the midst of dwindling government financial support (UGSP.1994).

Emphasis has to shift to the future direction of the institutions. In order to have successful institutions, there is the need to develop a vision of the future as well as a strategic approach for realizing that vision.

New methods of planning need to be developed that will deal with environmental factors. Strategies that would ensure greater success will have to be implemented as well as administrative plans of action to implement these strategies. Resources need to be allocated on the basis of creating an academic advantage, and systems of monitoring progress must be established to help ensure success.

Strategic planning therefore poses fundamental questions such as: Where have we been and where are we now? Where will we be in the future by following our present course? Where do we want to be? How will we get there? The successful performance of an organization therefore relates directly to effective planning, decision-making, and execution. An organization that determines where it plans to go, what it plans to do, and how it plans to do it can make better decisions, more effectively manage of resources and operations, and adjust more readily to change. (Green et al, 1985, Farrant, 1995).

The National Universities Commission, having realised the importance of strategic planning to the sustainability of the University system, had formulated a policy directive towards the effective application of the concept in all the Universities. As a starting point, the NUC started strategic pilot projects as far back as 1987. Various operational Departments in the NUC Secretariat commenced pilot projects with the aim of improving the efficiency of the overall sub-sector of the University system. The Academic Planning Department for example, embarked on the development of "parametric funding Model" for allocating recurrent grants using the Full Time Equivalent (FTE) students' enrolment. The Model was completed and is in use. The Department of Research and Development started the pilot project on Equipment Maintenance Centres with the overall aim of having effective Centres for the maintenance of Universities Laboratories' Equipment. The Department of Data Management started the strategic project on Management Information System (MIS) with the aim of establishing a database on students and staff records in the entire system.

Similarly, the Department of Finance and Supplies started a strategic project on Uniform Accounting System for all the Universities. It was only the Department of Physical Planning and Development of the NUC that was unable to start any strategic project that will ultimately serve the entire system.

This Research is aimed at bridging the gap, by establishing an Information system on physical facilities for the entire system, which will ultimately be used, for effective and informed decision-making. The starting point is therefore to create a computerised database for the system.

4.3 Developing a Data Collection Strategy

In order to establish a method for allocating capital funds based on transparent parameters, it will be necessary to develop a data collection strategy that would provide the information required to allow the incorporation of the condition of the building stock in the cost allocation model. Accurate and timely information will have to be based on accurate data which should be collected, processed and stored in a retrievable form. (BULL et al, 1994). Reliable data on capital projects that can be used for modern computerised planning is at best scanty or even non existent in some of the Universities. In order to establish a strategic plan, it is necessary to conduct performance auditing of the existing facilities in all the Universities. The starting point for successful implementation of strategic planning in the Federal University System is, therefore, to devise a method of data collection on the existing facilities that can be organised and stored in retrievable forms to build an information system for the Universities. The new information system can then be used for internal and external communication using the computer hardware and network infrastructure which are gradually being built within the University system. Already, since 1992, NUC had invested over two million ($2.0) Dollars (About £1.5m) in the procurement and installation of a comprehensive nine node state of the art Unix based Local Area Network (LAN) at its Headquarters in Abuja. The NUC has also been connected to the Internet system and E-mail facilities have allowed the Nigerian Universities to communicate with their counterparts all over the World. It has therefore became necessary that a process for collecting and collating the right data to create new information system be put in place.

In trying to create an information system for physical development in the University System, the first thing to do is to assess the condition of existing buildings and other facilities, evaluate their present use and create a database that will bring all the information together for management decision making. Accurate records of the available facilities and their present conditions are therefore vital in the process of creating the new information system. The information so generated would then provide the basis of planning for medium and long term maintenance strategies covering five to ten years in the future.

The costs of maintaining old buildings together with their services have increased tremendously over the years and the situation appears to be getting worse as the buildings get older and funding for capital projects dwindles. The need for planned maintenance strategy cannot therefore be over-emphasised. Demand for maintenance work has been classified into:

a. Reactive maintenance which addresses demand that have already occurred;
b. Medium term maintenance, which addresses demand that are predicted to occur in the next five years;
c. Long term maintenance, which attempts to profile the maintenance demand of a property or group of properties for longer period up to forty years.

In order to ascertain a medium or long-term maintenance strategy, it is essential to undertake a survey of the existing properties. Building Maintenance Information (BMI) Special Reports, (1988; 1995) classified three types of surveys usually carried out on existing property. These include:

(i) Structural Survey:

This is carried out to investigate the safety and stability of a building showing signs of distress. The objective of this type of survey is to identify failure and recommend remedies.

(ii) Dilapidation Survey:

This is a survey prepared in connection with leasehold properties. The objective of the survey is to identify changes in condition of the structure, services or finishes from the commencement to the end of the lease. The final schedule is only concerned with defects and gives no indication of the condition of those parts of the building considered to be satisfactory.

(iii) Condition survey:

This gives an overall assessment of the maintenance requirement to be carried out in the building at the time of the exercise. Its objectives include:

a. Identifying maintenance needs;
b. Recording the priority of the needs;
c. Recording proposed remedies and quantities of items requiring attention before the next survey; and
d. Recording the Scale of items requiring attention after the next survey.

The purpose of the assessment is to use the condition of the individual buildings as a basis for establishing the maintenance requirement of the entire system. The total requirements would then be used to distribute the available funds equitably, according to each University's maintenance needs. The assessed condition for each building will then allow the Universities to establish a list of priority projects to be executed over a period.

Since the structural and dilapidation surveys are unlikely to contribute much towards the achievement of this objective, only the condition survey was conducted for this project.

Up to-date information on the physical condition of buildings is essential to their effective operational management and to maintain their asset value (BMI) Special Report (1995 P.3). Planned maintenance policy is therefore an essential policy decision that must be taken by all the Universities in order to save the enormous amount of infrastructural facilities available on their campuses. In 1978, the NUCCON Group (NUC, Consultants), carried out specialist survey for the following areas in the University system between April and September, 1978 (NUCCON Final Handing Over Notes, 1979). The areas include:

I. Staff and Student Residential;
II. Furniture and Equipment;
III. Maintenance;
IV. Catering;
V. Medical Colleges.

The Surveys were only to the first generation Universities, as they were the only ones that had such facilities at that time and the exercise did not cover academic buildings, administrative and other supporting facilities. The specialist survey conducted was only to establish cost-limits for providing similar facilities in the second generation Universities being planned during the period. Furthermore, the survey was restricted to just investigating building types and layout in order to determine cost-limit of various buildings.

From 1978 to date, the number of institutions has increased from six to thirty in the Federal System. The buildings and other infrastructural facilities have increased while the condition of their existing properties has deteriorated. Since the 1978 preliminary survey, there was no further attempt to assess the existing facilities in the Universities. There is therefore the need to conduct a condition survey which will cover all the existing properties in the Universities' Campuses.

In their final report to the NUC in 1979, the NUCCON Group Consultants, recommended a follow-up on the surveys begun by the NUCCON. The Longe Commission Report (1992) supported the concept of surveying the existing facilities for planning purposes and recommended:

(i) Undertaking a survey to ascertain the degree of dilapidation or disrepair in each institution so as to provide it with an inventory of projects to be addressed, e.g. 1st Generation Universities, 2nd Generation Universities, 3rd Generation Universities with due regard to growth rates and any other relevant factors;

(ii) Establishing mechanism for monitoring and/or verifying claims of the institutions; and that the emergency nature of the situation in the institutions of higher education necessitated that the next ten years be declared a decade for Higher Education Restoration and Consolidation.

The Ndayako Report (1997) further supported the Longe recommendation and added that a Task Force should be constituted for higher Education institutions' rehabilitation.

In the developed countries on the other hand, planned maintenance management has developed to full capacity and there is available information for effective long and medium terms planning. Furthermore, with the new concept of facilities management, attention is being focussed on the necessity of controlling and managing occupancy costs. The use of tabulated occupancy cost-plan spread over thirty or more years of building's life provides guidelines for effective long term planning of maintenance costs (BMI special report, 1992). The present situation in the Nigerian University system is such that shortage of funds, neglect of facilities in the Universities coupled with over admission of students have caused a maintenance backlog over the years which now make planned maintenance imperative. The starting point is therefore a clear understanding of the existing physical conditions of the building and the demands on present and future cash flow. This is only possible by undertaking a condition survey of the buildings on all the Campuses.

4.4 Building Condition in the Nigerian Universities

The condition of a building is the aggregate status of the physical state of its elements at any particular time.

Ashworth (1988) suggested some factors which tend to make buildings inefficient or expensive to maintain. These include:

(i) Incorrect specification of materials used either initially or during subsequent repairs.

(ii) Incorrect use of spaces.

(iii) Poor constructional details resulting in inadequate weather resistance and rapid corrosion.

(iv) Inadequate care in use.

The author further observed that there was an increase in maintenance-cost with age for a variety of public buildings. Post-war School buildings were found to cost more to maintain in relative terms than Pre-war Schools. The evidence provided revealed that a larger proportion of the Post-war buildings were of a non-traditional construction (68% against 12%) and it was concluded that it might have been one of the causes of increased maintenance costs (Ashworth, 1988).

Building structures in the Nigeria University system suffer from all the factors identified by Ashworth (1988) and these factors are responsible for the high proportion of dilapidated buildings in the Universities. The report of the 1992 National Monitoring Committee on the ₦25.0 million (about $1.3m) special grant (NMC, 1994) observed that the buildings in the Universities generally, especially the Students' Hall of Residence, had dilapidated dangerously.

The situation has therefore necessitated the need for an assessment of the existing building in order to determine the quantum of the maintenance funds that would be required and to provide data for Strategic Planned maintenance for the urgent, medium and long term periods.

For the Strategic Planning purposes, the buildings would need to be classified in accordance with their existing functional uses and their design life. The British Standard (BS) 7543 (1992) categorises the buildings as follows:

Table 4.1 Categories of Design Life for Buildings

Category	**Description**	**Building life for category**	**Examples**
1	Temporary	Agreed period up to 10 years	Non-permanent site huts and temporary exhibition buildings
2	Short life	Minimum period 10 years	Temporary classrooms; buildings for short life Industrial processes; office Internal refurbishment, retail and warehouse buildings; (See note 1.)
3	Medium life	Minimum period 30 years	Most Industrial buildings; housing refurbishment
4	Normal life	Minimum period 60 years	New health and educational buildings; new housing and high quality refurbishment of public buildings
5	Long life	Minimum period 120 years	Civic and other high quality buildings
NOTE 1: Agreed life periods may be determined for particular buildings in any of categories 2 - 5 provided they do not exceed the period suggested for the next category below on the table, for example many retail and warehouse buildings are designed to have a service life of 20 years.			

Source: British Standard (BS) 7543 (1992)

Buildings in Nigerian Universities fall under category No.4 for Normal life of 60 years.

4.5 CONDITION SURVEY

Condition Survey of a building for maintenance is the process of assessing the maintenance requirement of all the elements in order to restore the building to its original functional state.

The main aim of a condition survey or condition assessment is to provide an evaluation of the current condition of all parts of a building and to identify deficiencies and provide costed remedies. BMI Special Report (1995 P.3) emphasised that the result of a condition assessment survey put the building, its components and systems, into a framework from which sound management decisions can be made.

Nigerian public sector buildings, particularly those in the Universities suffer from a backlog of maintenance repairs which must be identified in order to develop a realistic maintenance plan and to ensure that money is not wasted. Many buildings in the Universities have deteriorated to the point where systems have to be closed as in the case of (Jimbas buildings), University of Nigeria, Nsukka, or in some other places where the safety of occupants is at risk. It was observed that there is a relationship generally between maintenance costs and the age of a building.

Planning for maintenance work has therefore become critical in view of the maintenance backlog caused by shortage of funds over the years. Gomwalk (1999) declared that the level of funding of Nigerian Federal Universities has not only steadily declined in real terms, it has become grossly inadequate for the needs of our Universities. Similarly, Abdullahi (1999) traced the problems of under-funding to the very low percentage allocation of funds by the Federal

Ministry of Finance when compared with the total request submitted by the Universities. Furthermore, the amount allocated at the beginning of the year is in most cases, never released in full at the end of the year. Examples were the positions of capital allocations for the years 1998 and 1999 where the sums of ₦5.42 billion and ₦6.04 billion were allocated respectively. The actual releases to the Universities at the end of the years were ₦2.50 billion in 1998 and ₦ 2.99 billion in 1999, giving the shortfall of about 54% in 1998 and 51% for 1999.

Ciroma (2000) gave a picture of the expected capital budget in the year 2000, stating that the capital proposals by the Federal Ministries and Agencies for the year 2000 added up to ₦1,707.5 billion ($145,137.5 billion). However, only ₦ ₦170 billion ($14,450 billion) (9.96%) was eventually available for Capital expenditure for the entire nation. The need for careful planning in order to maintain the existing facilities, cannot therefore, be overemphasised.

Maintenance backlog is usually expressed as the cost of repairs necessary to return the building to its original condition. However, it may also be used as an indication of the cost of repairs necessary to maintain the building in use for a defined period, or by relating the time a particular component has been in use to its expected life and costing the replacement cost difference. It is important to ensure that the basis of maintenance backlog calculations remain consistent and has been related to current condition of the building. Funding decisions must often be based on which problems are the most severe or which will most increase future costs (BMI Special Report, 1995 P.4).

(a) **Condition Survey Data as a tool for budgeting**

BMI Special Report (1995, P.4) further stated that condition assessment forms a sound platform for the allocation and direction of usually scarce maintenance and repair funds, which take due account of a consistent assessment of actual need.

Analysis of data from a current condition survey related to a planned maintenance profile, projected for a period of about three years, based upon the expected remaining life of the building, its components and systems, together with a degree of flexibility (in the form of contingency) to cover for emergencies will therefore be the best method of establishing budgetary allocation to the Universities. Using the data from a condition survey will ensure equitable distribution of available funds according to the Universities' individual needs. The method will therefore satisfy the Government's requirement of basing budget figures on current information of immediate need.

(b) **Planning the Condition Survey Activities**

The scope and details of a condition survey may vary from simple investigation of one aspect of the building, to the whole building or series of buildings. The scope of a condition survey must, therefore, be designed to meet the management Information needs of the building owner (BMI Special Report, 1995, P.4). Decisions will need to be taken on which aspects of the buildings are to be inspected and the level of detail expected. The scope, methods and contents of the condition survey will therefore be determined by the purposes to which the results of the survey will be put by the building owner. For strategic policy making purposes for example, what is required is soundly based broad knowledge of the building condition across the Estate or University while for operational policy making detailed knowledge is required to establish precise work programmes. Since the aim of this research is to create an information system for strategic planning, only the broad information of the building condition would be required.

The scope, content, as well as the level of detail required from a condition survey also determine the level of expertise and skills to be involved. The use of standardised format, fixed checklists and guidelines are critical to the success of the process. Standardised procedures ensure that information is consistent from one building to another and from one inspector to another. The use of qualified and experienced staff who must be adequately briefed has been recommended. The formal briefing of surveyors carrying out the condition survey is essential if the building owner wants all facilities judged equally (BMI Special Report, 1995, P.5)

(c) **Condition Surveyor and the development of an Estate strategy document**

An Estate strategy document is a document containing a comprehensive list of all the built and landed assets of an institution. It will be capable of periodic review in the light of changing circumstances. It will also take a long term view of implementing proposals. BMI Special Report (1995, P.6) identified the key topics to be in the document as follows:

(i) Objective and Scope;
(ii) Data on the Existing Estate;
(iii) Performance Assessment;
(iv) Problems and Opportunities;
(v) Evaluation of Options; and
(vi) Proposals and Financing.

The current study will deal with only the data on the existing Estate, covering size, use, condition, value, fitness for purpose, space utilisation and running costs. Condition of the building appears to be the most important component of data on existing Estate.

It is the most vital criterion for efficient and effective use of a building for a given purpose since it impacts directly upon the functionality of space and the building. Assessment of existing building condition is therefore, the key to developing a realistic Estate strategy.

(d) **The Condition Survey process**

The type of survey to be carried out will usually depend upon the use to which the data collected is to be put. If the Estate to be surveyed has no current asset register or inventory of built or landed assets, it is normal to combine the condition survey with the preparation of asset register.

The process of conducting a condition survey involves three distinct phases. BMI Special Report (1995) identified the phases as:

Phase One:

Involving the setting out of the scope and content of the survey, selection of a Survey Team and the preparation of an action plan. Selecting Team members is the responsibility of the person directing the survey, (in this particular case the Researcher). The team members will require briefing/training on the method to be used to ensure consistency the precise data and the order in which it is to be collected. The method of reporting and personal responsibilities must also be defined.

Phase Two:

This will involve the actual collection of the data specified in the first phase. The data will normally include physical data on the building fabric finishes, services, plant and equipment, deficiencies which affect health and safety, fire fighting equipment and necessary data that would ensure compliance with building codes and legislative regulations. The level of data to be collected will depend on the purpose which it is to be used.

A survey for the purpose of approximate estimates of remedial works would need only a condition priority rating plus a spot estimate based on standard price guides. Alternatively, a condition survey that is to be used directly as a tender document for rehabilitation work will have additional forms for the detailed measurement and specification of remedial work.

The present study is aimed at providing data for strategic policy decision making and as such would require only the use of condition priority rating. Typical condition priority ratings for each elements and component of a building have been classified by Building Maintenance Information (BMI)document.

The common categorisation used are letters grading A to D as follows:

'A' means as new with expectancy that with proper maintenance, the building will provide a satisfactory standards of service;

'B' means, satisfactory, safe, with only minor deterioration which can be dealt with within the present existing maintenance budgets;

'C' means, the building is operational but major repairs or replacement will be necessary within a reasonable short period with costs outside the current maintenance programme; and

'D' means, inoperable, unsafe with a risk of immediate breakdown requiring urgent expenditure outside the current maintenance programme.

The classification of building conditions using letters, A-D will not allow the use of weighting factors to show the magnitude of the deterioration on the buildings. For the purpose of collecting data from the Nigerian Universities during this research therefore, figures 1-8 will be used to attribute weights to the building conditions on existing structures. While, figure 9 will be used for the structure that has not been completed.

1-4 means, presently the facility is in use

1. Means; as new with the expectations that with proper maintenance, the building will provide a satisfactory standard service.
2. Means, satisfactory with only minor deterioration which would require small amounts of money. Minor repairs here include such items like replacement of door locks, skirting and broken glass panes.

3. Means, safe but signs of fast deterioration are shown on some of the elements and would require reasonable amount of money to repair. The signs of deterioration here include the effect of weather on external painting, replacement of some plumbing fittings and replacement of some Electrical fittings.
4. Means, operational but major repairs and replacement of key elements will be necessary within a reasonably short period. Replacement of some key elements here include that of ceiling affected by the effect of leaking roof which was previously corrected external painting and re-decoration and replacement of many doors and windows.

5-9 means, presently the facility is out of use

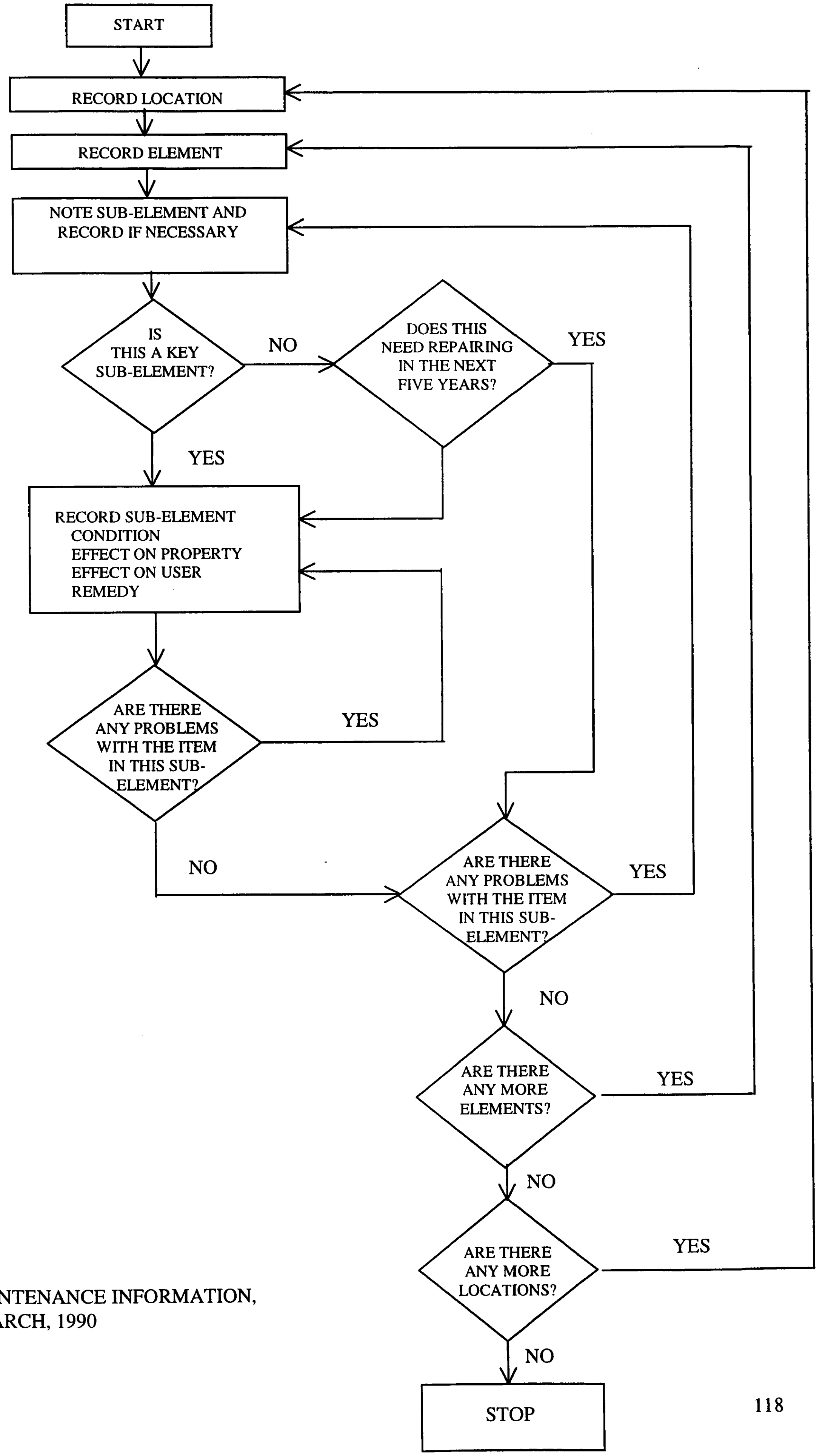
5. Means, inoperable and requires work on many elements. Work on many elements here includes that of the entire ceiling, internal painting and decoration, plumbing and electrical fittings.
6. Means, inoperable and unsafe until major elements are replaced. Unsafe here includes signs of cracks showing on the structural elements, collapse of part of the roof structure and so on.
7. Means, inoperable and unsafe with high risk of immediate breakdown. It requires urgent expenditure to save it from collapse. Unsafe here includes the total collapse of the roof structure, signs of major cracks on the structural elements and foundation.
8. Means, already collapsed and most of the elements have to be replaced.
9. Means the structure is not yet completed.

It is worth noting that, since the work is addressing maintenance strategy for the existing building stocks, structures that are not yet completed are not to be considered. Hence, condition 9 is excluded from the analysis.

The use of numbers 1-8 instead of letters A-D is to allow the application of weighting factor on each grade to reflect the severity of deterioration on the building condition. The process of conducting the survey is described in Chart 4.1.

Records of the pictures taken from a one of the sampled universities (Ahmadu Bello University, Zaria, Nigeria) based on the classification, are also shown on plates 4.1 to 4.6.

CHART 4.1: Process Condition Survey



SOURCE:-
BUILDING MAINTENANCE INFORMATION,
SERIAL 187, MARCH, 1990

PLATE 4.1

Condition 2: Rehabilitated Faculty of Science, A.B.U. Zaria, Nigeria as at 14-8-99

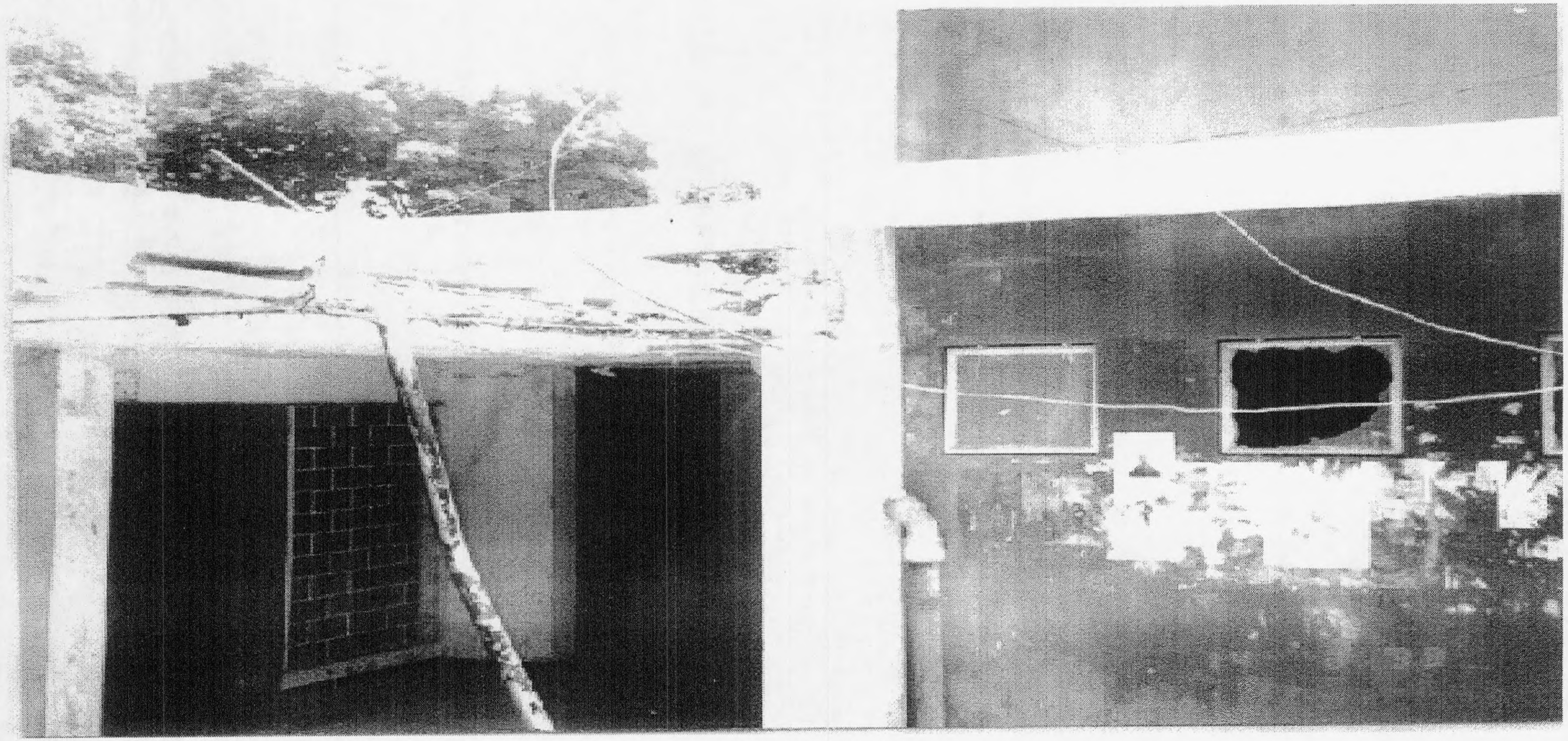
- This condition means, satisfactory with only minor deterioration, which would require smaller amount of money.
- Minor replacement of door lock, skirting and broken glass panels.

PLATE 4.2

Condition 3: Department of Chemical Engineering, A.B.U. Zaria, Nigeria as 14-8-99

- This condition means, safe but signs of fast deterioration are shown on some of the elements and would require reasonable amount of money to repair.
- The signs of deterioration here include the effect of weather on external painting, replacement of some plumbing fittings and electrical fittings.

PLATE 4.3



Condition 4: Faculty of Social Sciences, A.B.U. Zaria, Nigeria as at 14-8-99

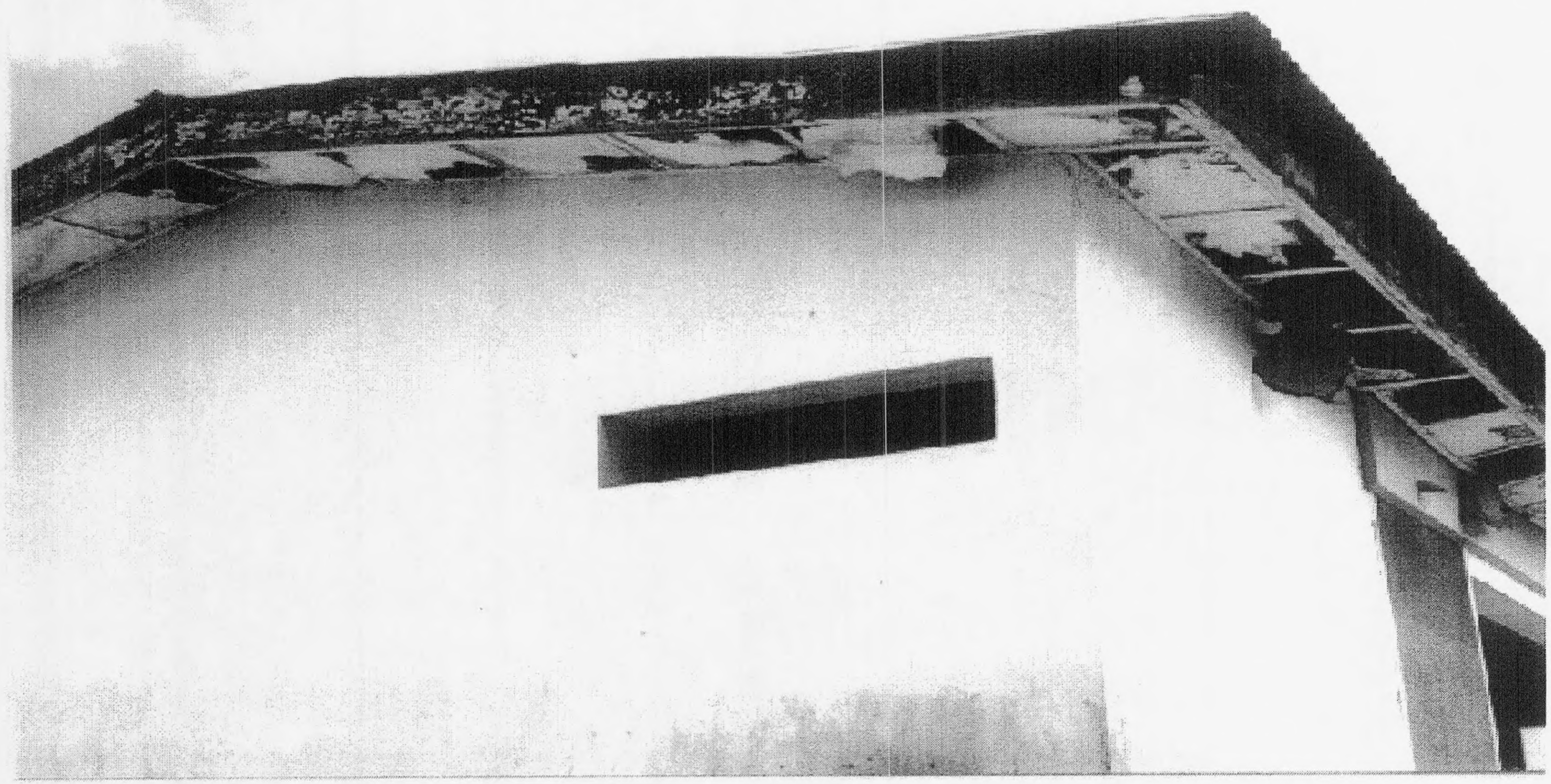
- This condition means, operational but major repairs and replacement of key elements will be necessary within a reasonable short period.
- Replacement of some key elements here include that of ceiling affected by the effect of leaking roof which was previously corrected, external painting and re-decoration and replacement of many doors and windows.

PLATE 4.4

Condition 5: Block of Students' Hostel, Danfodio Hall,A.B.U. Zaria, Nigeria as at 14-8-99

- This condition means, inoperable and requires work on many elements.
- Work on many elements here include that of the entire ceiling, internal painting and decoration, plumbing and electrical fittings.

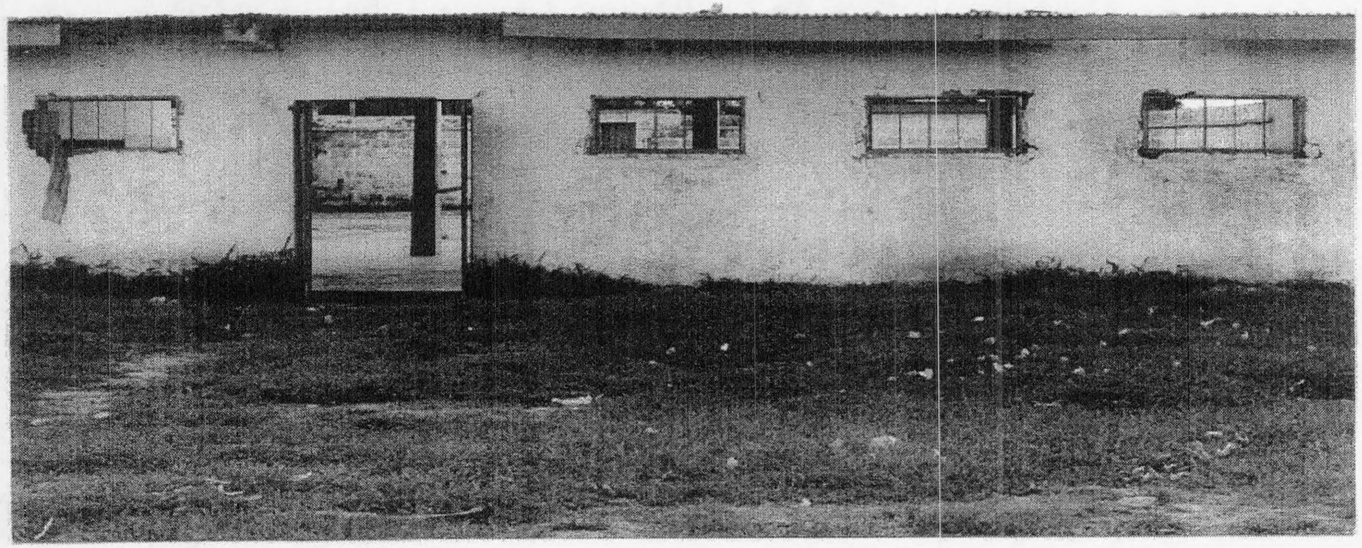
PLATE 4.5



Condition 6: Common Room Block, Danfodio Hall, A.B.U. Zaria, Nigeria as at 14-8-99

- This Condition means, inoperable and unsafe until major elements are replaced.
- Unsafe here include signs of cracks showing on the structural elements, collapse of part of the roof structure and so on.

PLATE 4.6



Condition 7: I & J Staff Club Block F A.B.U. Zaria, Nigeria as at 20-8-99

- This condition means, in operable and unsafe with high risk of immediate breakdown.
- It requires urgent expenditure to save it from collapse.

  Unsafe here include the total collapse of the roof structure, signs of major cracks on the structural elements and foundation.

(e) Costing a Condition Survey

Having inspected and graded the condition of the buildings, the next thing is to estimate the cost of repairing the defective parts observed. It is necessary to establish exactly what is to be costed. For instance, it is accepted that the general level of condition which can be considered satisfactory is 2 in this research work, it then follows that if the condition of the accommodation is unsatisfactory, and graded as either 4 or 5, then the estimate of repair costs would be that necessary to bring the standard of the building up to grade 2 and not to brand new condition of 1.

Since the work is addressing maintenance strategies for the existing building stock, structures that are not yet completed, coded as conditions 9 will therefore be eliminated from the analysis. Estimates for remedial works can be spot estimates rounded to the nearest whole number.

Schedule of rates of maintenance items such as cost per square metre of roof and other elements should then be drawn and applied for the assessment of the observed defects in each building. The total estimate for repairing the defective parts on any building constitutes the amount required for the building. The addition of all estimates from individual buildings give the overall estimate for the estate (BMI Special Report, 1988). A major consideration in costing condition survey is that the work included should be limited to those items necessary to make good defects in the building as it stands and not to include for enhanced standard of specification.

Once the costing is completed for the entire estate or University, the sum total required for maintenance is then made available. These figures and the assessed conditions of each building will form the basis of medium and long term planned maintenance. All data forms completed must be validated and analysed at the end of phase two.

Phase Three:

This involves the process of summarising and reporting conclusions and findings of the survey.

The findings of the survey for each University will be used by the National Universities Commission (NUC) to form the priority list for the University in that year.

Furthermore, the global conditions of all the buildings in the University System can be taken each year with the view of selecting worst cases to be addressed as National priority projects that can be funded directly from the NUC in order to save the initial investment. What this means is that at the end of each year, NUC can now assess its level of achievement by the number of buildings that change from conditions 5 to 4, 3 or 2. For building in grade 8, a decision to repair or demolish it has to be taken.

As emergency and reactive maintenance cannot be accurately predicted but must be carried out within a short timescale, they are considered to be wasteful of financial and human resources. BMI Special Report (1995, P.9) considered that the optimum time is such time when significant proportion (approximately 70%) of the total maintenance work on a building is being carried out as preventive maintenance. Data from the condition survey would therefore guarantee the achievement of this optimality over a period of time.

4.6 THE MODELLING CONCEPT

4.6.1 Evolving New Parameters for Allocating Capital Funds

As we approach the new millennium (21st century), the need to evolve new policies and strategies for allocating scarce resources in Nigerian Universities cannot be over-emphasized. It is necessary to evolve a rational allocation model which would allocate the scarce capital funds available to the Universities in order to maximise its use and increase efficiency. There must be conscious effort to prioritise the use of capital funds on specific projects within the system. The final performance report on the Special Capital Grants to the Federal Universities (NMC 1991), recommended that the National Universities Commission (NUC) should adopt a new strategy for the funding of new capital projects in the Universities; and also adopt the following procedure for implementation:

a. Each University should propose and submit total solutions to not more than two projects with the duration, cost and scope of work absolutely defined.
b. The NUC should then submit an annual list of such projects to Government for funding.
c. Government should fully fund an approved list of such projects giving stipulations on time limitations which should not be less than one calendar year. No University should be eligible to propose any further project until it has completed its current funded projects.

The Cookey report (1981) had earlier established that only about 50% of the total capital expenditure in the Nigerian Universities is expended for the provision of Academic Facilities and government was advised to promulgate a policy of segregative financing of physical facilities on the campuses (Aminu, 1986). In a similar call to financiers of African Universities, the Association of African Universities (AAU, 1997) advised that strategic choice must be made to fund the areas and facilities which are likely to produce the greatest developmental benefit to the Institution.

Each University operating with its budgetary provision should therefore seek to identify, develop and maintain one or more academic facilities which is crucial to its mission statement in particular and the country's economic advancement in general.

Earlier researches conducted (Samaila, 1996, Bankole, 1996) had confirmed the gross inadequacies of academic facilities in the Nigerian University system. Similarly, Abdullahi (1996) had discovered from the analysis of 1997-99 Rolling Plan of the Federal Universities that the Universities planned to expend their percentage total capital funds for the three years on Teaching and Research facilities as follows:

1st Generation Universities, an average of 36.56% of ₦345 million each.
2nd Generation Universities, an average of 38.33% of ₦359 million each.
3rd Generation Universities, an average of 61.31% of ₦381 million each.
4th Generation University of Abuja, an average of 71.38% of ₦331 million.

It was concluded that the effect of skewness in capital allocation in favour of other facilities is responsible for the acute shortages of teaching and research spaces, thus causing over crowding in the lecture halls, as a result of increased students enrolment operating within fixed spaces.

The Ndayako Report (1997, P.142) confirmed the gross inadequacy of academic spaces in the Universities and noted that "no meaningful teaching or learning activity can possibly take place in a situation where a Chemistry class of about 2,000 students is squeezed into an inadequate academic space, and for a staff strength meant for 470 students"

It is in view of the above that the research work focusses on evolving parameters which would allocate funds to academic facilities to address the problems.

4.6.2 The New Parameters to be used in the Model

Ferry and Brandon (1991, P.252) defined a parameter in the context of building cost, as "a quantity which is constant in a particular case considered, but which varies in different cases". A Model can be defined as a symbolic representation of a system expressing the contents of that system in terms of the factors which influence it. From the definition of a model given, the significant items or components of capital projects in the University System for which the model is being developed include:

(a) Students enrolment;

(b) Full Time Equivalent (FTE) student;

(c) Usable space required by FTE student;

(d) Existing usable teaching and research spaces in the system;

(e) Differential growth rate in students numbers in different subjects as they affect total space requirement; and

(f) Weighted FTE space, using the standard space per FTE to determine the relative space needs of different Academic subject categories and ultimately the space need of the University.

(g) Using the weighted space factor for distributing and allocating the capital grants

(h) Making special allowance from the total grants each year for Nationally Strategic Projects within the system.

(i) Student Enrolment

The Student enrolment in a Department is the total number of all students registered for all the degree programmes offered by that Department. The sum total of all the students in various Departments of the University constitute the students enrolment of that University.

(ii) The Concept of Full Time Equivalent (FTE)

Liverpool et-al (1994) described the concept of Full time Equivalent as a planning parameter which can be used for budgeting, space allocation, derivation of unit costs, derivation of excess work load and in many other areas where there is a desire to allocate resources in relation to rational need and work load. The concept is an indicator of student enrolment and arises out of a need to define students enrolment in equitable terms, for resource allocation. The FTE students concept therefore gives a better perspective of the actual number of students a department caters for than head count. Student enrolment in this case, has been conceptualised in equitable terms. It is a more realistic parameter for determining enrolment other than that in which their programmes is based and it gives credit to Department for its service courses (Liverpool, 1994, 1999). The National Universities Commission (NUC) has sponsored a study to formulate the calculation of the FTE on a uniform basis for all the University System.

(iii) Growth Rate Specified For The Universities Generations

The Federal Government has specified different growth rate at which the Universities are expected to develop up to the point of reaching their ultimate enrolment.

The different growth rates across the generations are as follows:

(a) First Generation Universities 2.5% per annum

(b) Second Generation Universities 10% per annum

(c) Third Generation Universities 15% per annum

The National Universities Commission has however, considered and amended the Growth rate for the Universities in 1998. The new grouping is as shown in table3.2.

TABLE 4.2: NEW GROUPING OF GROWTH RATE

Category	Enrolment Rate	Growth Rates
Group 1	16,000 - 30,000	2.5%
Group 2	10,000 - 15,999	5%
Group 3	below - 10,000	10%

(iv) Weighted Space Factor Per FTE

From the standard usable space per FTE student provided in the Guide, a weighted space factor is arrived at by multiplying the total number of FTE for a particular programme with the equivalent standard usable space for that programme. For example, if the total FTE enrolment of department X is 200, and which has usable area per FTE of 9.50 m^2/FTE, then the total weighted space for the department will be 200 x 9.5 = 1900 m^2.

The concept of weighted space can be used as a means of determining the relative space needs of different academic subject categories and ultimately the space need of a University.

The concept of space weighting has general international applications and acceptability. The three Funding Councils of the United Kingdom (UK) namely:

a. Higher Education Funding Council, England;
b. Scottish Higher Education Funding Council, and
c. Higher Education Funding Council for Wales;

jointly commissioned a study on space weighting in 1995. The report of the study known as TOUCHE ROSS (1995), has been accepted by both Councils and is now in use in the UK. The report summarised the conclusions of a nine month study into patterns of space use among higher education institutions in the UK. It defined weighting to reflect the relative space needs of both researchers and taught students in different academic subjects areas. The main purpose of the space weighting according to the report is to provide an equitable basis for comparing the outcome of space use practices between Higher Education Institutions.

The study covered the whole of Britain using sampled institutions. The group also examined the spaces being used by private sector especially those agencies dealing with research and research findings. The study further reviewed the space planning in Higher Education institutions found around the World. North America, Australia and Europe were considered for the review and the findings compared favourably with their final recommendations. At the end of the study, Teaching and Research space weighting were developed for sixteen (16) cognate groups (Touche and Ross 1995).

Incidently, the space weighting developed by these international Consultants compared favourably with the usable space per FTE, provided in the Standard Guide for Nigerian Universities. The standard were also first developed in 1977 by a group of International Consultants known as the National Universities Commission Consultants of Nigeria (NUCCON) on behalf of the Nigerian Government. The documents were reviewed in 1994 and are currently under the second revision.

4.6.3 The Conceptual Design of a Cost Model

A Model as defined, is a symbolic representation of a system, expressing the contents of that system in terms of the factors which influence it (Ferry and Brandon, 1991). It is therefore an attempt to represent the significant items or components of the system in a form which would allow analysis and predictions to be undertaken according to some changes in some factors or variables. The modelling concept is therefore aimed at simulating a current or future situation in such a way that the solutions posed in the simulation will generate results which may be analysed and used in decision-making process.

The modelling concept has been used by many Researchers in recent time to find solution to variety of problems in the construction industry. Okoroh and Tourance (1999) used the concept to produce a model for selecting subcontractors in refurbishment projects, Chan and Kumaraswamy (1999) produced a model for predicting construction duration in Hong Kong, Zhai and Jefferey (1999) produced a stochastic model for the prediction of contractor's default risk while Iam and Kuneson (1999) used the concept in modelling financial decisions in construction firms.

Previous studies on Cost Modelling have concentrated on estimating the cost of a proposed building or Civil Engineering project (Ashworth, 1988). The assessment of the unit rates (prices), either for an approximate estimate or during the preparation of a tender, is usually based upon some assumed standard output. These outputs are then subjectively adjusted by the skill of the Estimator or Quantity Surveyor. The method is being used with some reservations as it is believed that little is done to verify by reference to previous site performance, whether the adjusted rates are correct.

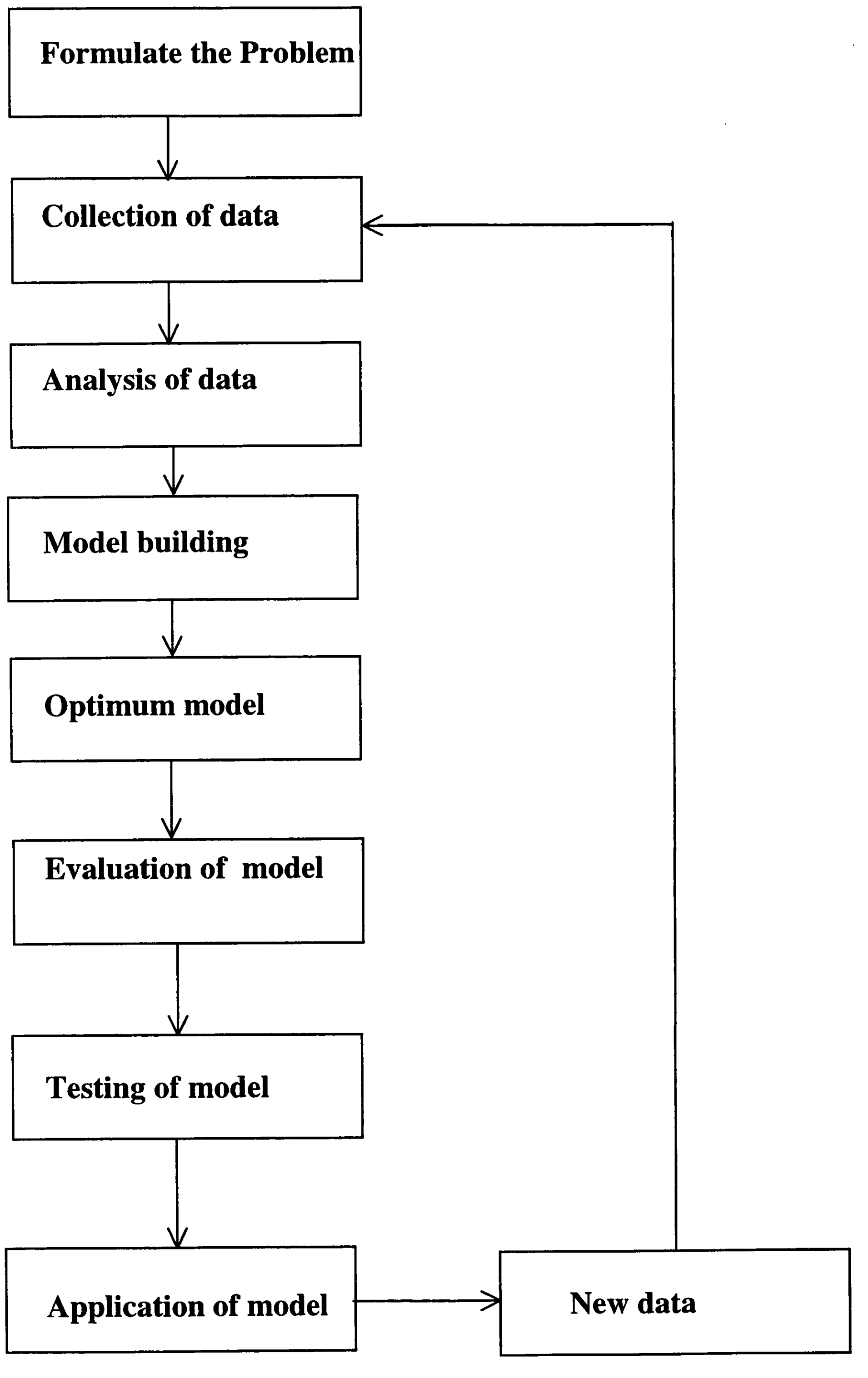
Major advances in the construction price determination in the recent years resulted in improved techniques for use at the design stage. Cost planning techniques were then developed during the 1960s by the then Ministry of Education in the UK. The Royal Institution of Chartered Surveyors (RICS) also organised the building cost advisory service which was later changed to Building Cost Information Service (BCIS). The early methods of price forecasting were therefore derived in an attempt to improve the quality of only the price forecasting. Several research projects have also sought by various means to improve the accuracy of pre-tender estimating .

Further attempt to improve the Contractor's estimating performance brought about the introduction of two approaches to cost estimating, using computers. The first approach sought to computerize the traditional methods already being used while the second method sought for a radical approach to the problem of estimating by devising an entirely new method of price forecasting. The methods in the second approach use the computer to manipulate data often within complex mathematical formulae. The second approach brought about the development of cost models which have equal applications for both the Client's cost managers and the Contractor's estimators. When a cost model is being developed, it is always constructed to be as universal as possible, so that it can be applied to a large number of cost situations and building forms.

The basis of the model is therefore an abstract hypothesis which is made real or firm by the application of quantities and cost to its parameters Raftery (1991) (Ferry and Brandon, (1991) P.252). Ashworth (1988, P.272) gave a useful distinction in model building between deterministic and probabilistic models. The deterministic type model presupposes that values can be attributed to all variables, it assumes that these are either known or can be predicted exactly. The probabilistic model on the other hand recognizes that the values of some variables will be uncertain and can therefore only be estimated. The probabilistic models therefore use the concept of probability theory.

The process of model building can be considered as follows:

CHART 4.2 Cost Modelling Process



Conceptual model design process would therefore have to pass through three distinct stages. These stages include; Analysis stage, Synthesis stage and

Appraisal stage:

I. at the Analysis stage, the problem is researched in order to obtain an understanding of what it is required;
II. at the Synthesis stage, the information obtained in the analysis is used to converge on a solution at the level being investigated; while
III. at the Appraisal stage, the solution is represented in some form which is then measured and evaluated.

4.6.4 Building a Mathematical Cost Model

Draper et-al (1988) identified three types of mathematical Models. These include:

a. The functional Model;
b. The control Model; and
c. The predictive Model.

In the process of identifying the necessary parameters for capital fund allocation which involves some amount of estimation and prediction, the predictive model will be the most relevant to the work, and will therefore be used.

(a) Methematical Methods of Cost Modelling

Current literature on cost modelling using mathematical formulae approach provide three different methods of building a model. These include:

I. The empirical or causal method;
II. The regression analysis method;
III. The simulation method; and

(i) **The Empirical or Causal Models**

These types of models are symbolic models which are based upon observation, experience and intuition. Ashworth (1988) argued that these types of model have been used and developed largely on the basis of "right feeling". He contended that within their limitations, their thinking has largely become towards a common sense method of understanding, application and presentation. Bills of Quantities are considered to be typical example of empirical model, where the physical appearance of the building and the methods used for construction have been modelled in terms of descriptions and dimensions.

It is to be noted that the empirical models as being used at the moment do not really take into account the complex plan shapes or the large number of storeys.

Ferry and Brandon (1991) observed that in the empirical method, the building components are expressed in algebraic terms, values are then given to the terms and cost coefficient applied to arrive at cost estimate. An example can be given in the process of estimating cost of a concrete slab 150mm thick with:

Length = L and Width = W and

A cost factor (rate per m^2) = CF_1

Cost of slab = L x W x CF_1

This method is used for cost planning and estimation for a new building project.

(ii) Regression Model

The empirical model assumed that there is a fixed relationship between the design variables and cost and that the cost factor applied to the algebraic formula is constant. However, in construction related activities, where human performance is involved, exact relationships are not generally observed. Statistical relationships however prevail and only average relationships may be observed among the variables (Ferry and Brandon, 1991). Trend may be detected in a given data that was analysed and it may be possible to determine a trend algebraically, and to allow an estimate of cost to be made, if some of the design variables are known. Draper Et-al (1988) defined a Regression model as a model of determining the relationship between variables by the method of least squares, which seeks to minimise the sum of the squares of the difference between the observed values and the predicted values. In the construction sector, knowledge of some variables such as the height of a building, its shape, floor area (m^2) may provide a more reliable forecasting of its cost, using this technique than using one of the traditional single price methods of estimating.

Regression analysis is therefore a method whose estimates are made of the value of a variable (e.g. cost) from a knowledge of the value of one or more other variables (e.g. building height, shape or floor area), and the errors involved in this estimating process measured. The relationship between two variables is described by computing a straight line through the data obtained. This is known as two variable linear regression and represented as

$$y = a_o + bx$$

When more than two variables are involved, the situation is considered to be multi-variables linear regression and represented as

$$y = a_o+b_1x_1+b_2x_2+b_3x_3+\text{error}$$

The factor whose value is being estimated (e.g. Cost) is referred as the 'dependent variable' and denoted by y. While the factor from which these estimates are made is called the 'independent variable' and denoted by x.

The technique has been applied reasonable level of success to reinforced concrete frames, simple building type and even services installation. The problem however is that the choice of variables is left to the user, who may leave out a most important variable because he does not know of it, or does not consider it worthwhile.

(a) Regression Process

The process of estimating or predicting the value of a dependent random variable y on the basis of a known measurement of an independent controlled variable x is known as regression process (Walpole, 1974).

A first step which is sometimes taken in determining the equation between the variables is to draw a scatter diagram. This is a pictorial representation of the data on a set of axes which shows how the two variables relate to one another. Scatter diagrams may be used to obtain a general approximation or rough indication of the relationship between data. In certain cases a scatter diagram may be used to obtain a general approximation which expresses the relationship between the data. In other cases a scatter diagram is a useful rough and ready check on the results of the mathematical analysis. Scatter diagrams are also useful for identifying out layers or odd observations which might not really belong to the data.

Once the data has been plotted on the scatter diagram it may be possible to visualize a smooth curve through the centre of the data which could be said to present the general pattern of the data. Such a curve is called approximation curve.

While it is possible to establish approximations of these curves by observation and by free hand drawing, these may be more accurately established with the help of a simple mathematical procedure.

The simplest type of mathematical curve fitting uses a straight line whose equation may be expressed as:

$$y = a + bx$$

In this equation, b_1 is the slope or gradient of the straight line and this represents the rate of change in the variable y for a given change in x. The rate of change is calculated by dividing a change in y by the corresponding change in x. The sign of the slope is most important. If it is positive, as x increases or decreases so y will change in the same direction. If the slope is negative, the value of x and y will change in opposite directions.

The a-value is the constant or intercept on the y axis. That a is the value of y when x is zero. It is a base value of y before any increases or decrease in x are taken into account.

(b) Line of best fit

To establish the equation a line of best fit is calculated. For any given value of x i.e., x_1 will be a the difference between y_1 and the value of y determine by the curve. This difference can be denoted by d often referred to as deviation error or residual.

The best fitting curve is defined as that line through a set of data which has the property of minimizing the sum of any given set of ds. This is referred to as the least square line.

Given that:

$$y = a + bx$$

is the form of the relationship, in the best line that minimizes the d-values, the expression b_1 and a are as follows:

$$b = \frac{\sum xy - n\overline{x}\overline{y}}{\sum x^2 - n\overline{x}^2}$$

$$a = \overline{y} - b\overline{x}$$

$$r = \frac{a\sum y + b\sum xy - n\overline{y}^2}{\sum \overline{y}^2 - n\overline{y}^2}$$

where n = The number of data point available

3x = The sum of the x data points

3y = the sum of the y data point

3xy = The set of the product of each set of data.(Ferry and Brandon, 1991 P.265)

Having established the equation representing the least square line, an estimate of a value of y corresponding to a value of x may be obtained. For example in our study a simple relation can be established as follows:

cost of renovating a building = a + b (age) where a and b can be determine as shown earlier.

This is because there will seldom, if ever be a direct relationship between x and y in linear regression analysis.

The above equation is often expressed as

$$y = bx + a + e.$$

Where 'e' is the error

This error represent the lack of precision in estimating one variable from another.

(c) Multiple Linear Regression

Multiple Linear Regression is an extension of the methodology described above. Multiple linear Regression extend the description of the relationship by the use of more than one independent variables. In most cases by using more than one independent variables, a better explanation of the variation in y can be obtain and hence provide more accurate prediction.

In the field of property development, a common application of multiple linear regression is found in residential property value assessment. In this instance, the objective is to estimate the value of a residence 'y', based on certain descriptive information. These descriptions information may include:

x_1 - Square metres of living space in the residence;

x_2 - Number of bedrooms;

x_3 - Number of bathrooms;

x_4 - Age since initial construction; and

x_5 - Total number of rooms.

This is simply an extension of the simple regression where there are more than one independent variables. In relation to the project research, new independent variables like condition of building ,floor area and age after renovation can be added. A simple representation of the relationship is therefore

$$y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + e.$$

This prediction equation can be obtained by the method of least squares in exactly the same way as that employed for the simple linear regression. It is important to ascertain if all the variables proposed for the multiple regression model are required. This is because simpler models that approximate the multiple linear regression model well require less data collection , are easier to interpret and may be more accurate. There are also various ways of choosing a suitable subset from all the regression variables.

(d) Types of Mathematical Models

Four possible methods of regression were identify by Draper Et-el (1988). These are:

1. All possible regression;
2. Backward elimination;
3. Forward selection; and
4. Step wise regression.

(i) All possible Regression

In this procedure, all the variables will have to be examined and this makes it rather cumbersome. It is therefore quite impossible to do without the use of high speed computers. The procedure first requires the fitting of every possible regression equation which involves 's before final selection. The amount of computer time used in this procedure is considered wasteful and some sort of selection procedure which shortens the task is preferable.

(ii) Backward Elimination

Backward elimination starts with the model containing all the dependent variables and then at each stage eliminates the least significant variables (as measured by the partial F-test) until no variables remain. The researcher then chooses the most economical model based on criteria such as the t ratio or the coefficient of determination(R^2). It should be noted that this approach requires much less computing resources than all possible regressions but suffers from the draw back that once a variable has been eliminated it cannot be restored to the model.

(iii) Forward Selection

While the backward elimination method begins with the largest regression, using all variables until a decision is reached on the equation to use, the forward selection procedure attempts to achieve a similar conclusion but working from the other direction, using partial correlation coefficient as a measure of importance of variable not yet in the equation. The forward selection procedure is considered to be good because it economises computer facility than the backward elimination method. Its major draw-back however is that it takes no effort to explore the effect that the introduction of a new variable may have on variable which has entered into the equation at an earlier stage. This deficiency is overcome by the step-wise procedure, which is an improvement on the forward selection method.

(iv) The Stepwise Regression Method:

This procedure is an improvement of the forward selection method. It involves the re-examination at every stage of the regression of the variables incorporated into the model in previous stages and compares it with a pre-selected one. In this way any variable which provides a non-significant contribution is removed from the model. The stepwise procedure starts with the simple correlation matrix and enters into regression the "X" variable most highly correlated with the response. The method then examines the contribution of the new variable with the contribution of the ones previously entered.

This method is believed to be the best for selecting variable and also believed to be the best procedure to be used when dealing with problems of practical nature. In view of its immense advantages, the stepwise regression procedure is selected for use on the data collected for this project.

(v) **Model Output and the Context of its Application**

In the development of a model, there will be various attempts at modelling the data. In each model to be discussed, the output include:

1. The coefficient of the independent variable;
2. The T-value;
3. The goodness of fit; and
4. Analysis of variance.

The coefficient of each independent variable is the change in cost of repair for a unit change in variable 'I'. The sign of this coefficient is important as the negative sign means that the variable contributes negatively to cost of repairs. For example, in all the models to be discussed, floor area has a negative coefficient; the more floor area per building the less the estimated cost of repair, every other thing being equal.

The T-Value

A frequently tested hypothesis is that the coefficient of the independent variable (B) is zero. The statistics used for testing this hypothesis is the T-statistics. Large value for T indicates that the alternative hypothesis, that is $B \neq 0$ is true.

By the stepwise regression method, any variable with a B which is insignificant is removed from the model. Large values of t and p value of less than 0.01 is required for a variable to enter into the model.

Goodss of Fit

R^2 Coefficient

An important part of any statistical procedure that builds models from data is establishing how well the model actually fits. A commonly used measure of the goodness of fit in linear regression model is R^2. R is defined as the correlation between the actual dependent variable and the predicted value from the model. The output shows R^2 at progressing process. The rows label of the various coefficient for each step of the regression is shown in column 1.

Analysis of Variance

The value R^2 is a measure of the usefulness of the model. We can test the hypothesis that R^2 is equal to zero (or the model is useless). The test statistics is the F value. The F statistics for testing the usefulness of a model i.e., testing the null hypothesis that all model parameter equal zero is given by the formula below:

$$f = \frac{\text{Meansquare(ofmodel)}}{\text{Meansquare(oferror)}}$$

This ratio is the ratio of the mean square of the variance explained by the regression to the mean square of the variance unexplained by the regression. If the numerator of the above ratio is large, comparably, therefore, more of the variance in the dependent variable is explained by the regression, hence the F- value would be large and the significance of F would be small. The significance of F is the probability that R = 0.(McClave et al, 1994)

Practical Applications of Linear and Multiple Regression Analysis

Linear regression concept has been applied to predict the duration of construction project in the construction industry.

Bromilow (1974) for instance, used the concept to develop a model which predicts construction time in the form of a formula

$$\mathbf{T = KC^B}$$

Where **T** is the duration of the construction period from date of site possession to practical completion, in working days, **C** is the final cost of building in million of dollars, adjusted to constant labour and material prices, **K** is the constant describing the general level of time performance for a $1 million project and **B** represents a constant describing how the time performance is affected by project size, as measured by cost. The model indicates that the cost of a project principally determines the construction time. Knowledge of the construction cost and the constants will therefore allow for a good estimate (forecast) of the construction time. The use of Linear Regression Method of estimation to forecast a dependent variable (construction time) from known independent variable (construction cost) has therefore provided a good measure of prediction, which can be applied to similar circumstances.

Chan (1999) therefore applied the concept to develop a model for predicting construction time in Hong Kong from the data collected on 110 Public and Private building projects. A simple Linear Regression analysis was used to validate the Bromilow's (1974) time-cost relation. The Researcher used the relationship to estimate the likely construction time required for a given type of project. Chan (1999) concluded that the statistical equation in the form of $\mathbf{T= KC^B}$, holds for the sampled projects; where **T** represents the duration of the construction period from the time of site possession to practical completion, in working days, **C** represents the final cost of the building in million dollars, adjusted to, constant labour and material prices, **K** represents the constant describing the general level of time performance for a $1 million project and **B** represents a constant describing how the time performance is affected by project size, as measured by cost.

Chan (1999)'s findings provide the necessary assurance of the application of Linear Regression Method to estimate a dependent variable from known independent variable.
When many variables are involved in the prediction process, the use of Multiple Linear Regression Method becomes inevitable.

In trying to predict demand for residential construction in Singapore, Bee Hua (1996) used the concept of Multiple Regression forecasting technique with the help of twelve economic indicators to make the prediction demand. Stepwise procedure was used to select the 12 indicators that were significantly related to Gross Fixed Capital Formation (GFCF) for residential buildings. All of them met the 10% significance level specified in the procedures. The list of the indicators is as follows:

(1) Per capita GDP (DCAPGDP).
(2) GFCF (construction and works) GFCFCON).
(3) Real GDP (REALGDP).
(4) Building material price index (BLGMAT)
(5) Money supply (MS).
(6) Money supply (savings and others) (MSAV).
(7) CPF withdrawals (home ownership) (CPFWITHD).
(8) Prime lending rate (PRIMELR).
(9) Consumer price index (CPI).
(10) Property price index (residential) (PPIRES).
(11) Labour force (LABFOR).
(12) Unemployment rate (UNEMPRT).

The indicators served as independent variable in a statistical equation of the form

$$\mathbf{D = bo + b_1X_1+b_2X_2 \ldots\ldots\ldots\ldots\ldots\ldots b_{12}X_{12}}$$

Where **D** is the demand for residential construction, **bo** is the constant $\mathbf{b_1}$-$\mathbf{b_{12}}$ are the co-efficient while $\mathbf{X_1}$-$\mathbf{X_{12}}$ are the independent variables. Bee Hua (1996) was able to forecast the demand for residential construction using the techniques of Multiple Linear Regression.

Similarly, Leung and Tam (1999) used the concept of Multiple Linear Regression to predict the hoisting time for tower cranes for public housing construction in Hong Kong.

Adopting Multiple Linear regression techniques with SPSS computer software *(SPSS,1993)*, the authors analysed the data obtained from twenty-seven sites visits on 278 cases recorded for installations of the precast concrete units and seven visits with 88 cases precast slabs. Twelve independent variables emerged at the end of the analysis for the supply time **St**, as shown below:

$\mathbf{X_1}$ the angular movement (swing angle) in degrees.

$\mathbf{X_2}$ the radial movement (trolley displacement) in metres

$\mathbf{X_3}$ the weight of the load in kilograms

$\mathbf{X_4}$ the length of the load in metres (the longest dimension)

$\mathbf{X_5}$ the area of the load in metres squared

$\mathbf{X_6}$ the loading position in metres (radial distance)

$\mathbf{X_7}$ the unloading position in metres (radial distance)

$\mathbf{X_8}$ the hoisting height

$\mathbf{X_9}$ the capacity of the crane in metre-tonnes

$\mathbf{X_{10}}$ the view of the operator

$\mathbf{X_{11}}$ interference between cranes

$\mathbf{X_{12}}$ the orientation of the load

The relationship between the dependent variable $\mathbf{S_t}$ and the independent

variables $\mathbf{X_{1-12}}$

was expressed by means of an equation:

$$S_t = b_o + b_1x_1 + b_2x_2 \ldots\ldots\ldots b_{12}x_{12}$$

Where $\mathbf{S_t}$ is the supply time for a crane hoisting a load from a loading point to an unloading point. x_1 represents one of the twelve independent variables, and $\mathbf{b_o}$ is the constant and $\mathbf{b_1}, \ldots\ldots \mathbf{b_{12}}$ represent the coefficient. A variable with largest positive or negative correlation was tested at significance level of **0.05** for **F – test**. The default value for removal was set at **0.1** significance level. The result of the analysis gave a value of fitness ($\mathbf{R^2}$) of **70%** (0.7) indicating a high relationship between the predicted value and the actual value.

The **methods** described above which employed the techniques of Linear and multiple regression statistical approaches to varying data input therefore provided a basis for application on this research which has a number of variables such as, age of building, condition of building and floor area.

(iii) Simmulation Process

(a) Monte Carlo Simulation

The Empirical and Regression models attempt to describe the cost of the building in algebraic or statistical terms so that the cost effect of changing one or more design variables can be estimated. However, there are problems associated with the variability of such basic data, as well as the difficulties in predicting what will happen in the future especially in the developing country like Nigeria whose economy is totally dependent on oil revenue. A better approach to cost estimating is like to be arrived at by defining a likely range of values for the unit cost of an item and the likely range of the inflation rate over a determined period of time. A technique that allows the use of probable range assumptions of values to explore the possible cost solutions available using the value would improve the cost prediction and forecasting. Similarly, by repeating the exercise for two or more alternatives and obtaining a distribution of solutions for each, a comparison of results can be undertaken to see which solution has the highest probability of being the most economical choice over the likely range of circumstances. Over the years therefore, the Monte Carlo technique has been considered as one of the techniques for such approach. Ferry and Brandon (1991, P.270) described the Monte Carlo technique as one method by which we can simulate activities over time of a kind which could not be represented adequately by any of the theoretical models. They described simulation in the context of construction sector as a means of creating a typical life-history of the system (e.g. the total building, the production process, maintenance, costs in-use) and activities under given conditions, working out step-by-step what happens during each unit of life of the system. In order to undertake such an exercise however, the detailed characteristics and operation of the system and the relevant distributions must be known. The use of Monte Carlo Simulation method would assist in decision-making since it would provide more information on the range of possible future.

Slaughter,(1999) used the simulation principles to develop a model that would examine and improve the construction process. He concluded that simulation provides a new means through which to examine and improve construction process. The model was also used to asses the impacts of incorporating innovations into specific construction process systematically.

Ferry and Brandon (1991, P.271) however, observed that perhaps the most difficult forecast to make with regard to buildings is the cost of running and maintaining the property, not only because there are so many factors affecting the way the building performs (maintenance strategy, standard of use, design detailing, workmanship etc) but also because of the long period of time over which the prediction must be made.

Buildings and other infrastructures in the Nigerian Federal Universities were developed at different times and are at different levels of dilapidation. This is the reason why an equitable distribution of available capital funds to ensure allocation to the Universities in accordance with their needs cannot be over-emphasized.

Ashworth (1988, P.281) stated that one of the advantages of simulation is that problems can be solved which is not possible analytically.

Simulation principles will therefore be applied to explore the potentials of arriving at an optimum strategy of maintaining the existing building stocks in the Nigerian University System.

(a) Criteria for Developing a Good Cost Model

Ashworth (1988, P.284) provided the criteria for a good cost model to include:

1. The data requirements for the model should be freely available in the form and amount.
2. The model should allow for continuous updating by incorporating new data that become available.
3. The model should be capable of evolving to suit the need of a changing

situation.

4. The entire process of cost model management should be able to be done quickly, cheaply and efficiently.
5. The model should accurately and reliably represent that which it is attempting to predict.

During the process of constructing a predictive model, the principles of multiple regression techniques would have significant contribution. It is envisaged that various parameters would be developed during the analysis of the data on this project. It would then be necessary to apply the concept of predictive model to estimate the dependent variable in the form of the amount to be allocated to a particular University each year, based on its needs.

The process of constructing a Mathematical Model also involves three distinct phases, namely, Planning, Development and Verification and Maintenance. During the planning stage, specific statement of the problem should be defined, responses are selected and variables are suggested. The proposed variables should be fundamental to the problem and their availability should be ensured. At the end of the planning phase, the problem should exhibit some potentiality of being solvable.

At the Development phase, various data are gathered; test run and preliminary analysis conducted, Predictive equation formulated, modification and improvement of the model carried out, before the project is finally completed (Drapper et al, 1981).

After an equation meets the goals set during the planning stage and is acceptable as a useful predictive model, it will be necessary to establish procedures for verification and maintenance.

The stability of the parameters should be tested over the sample space, to see the pattern of successive estimate over a period. It has to be ensured that the co-efficient are reasonable to allow for practical use of the model.

Having satisfied all the criteria and necessary check points, it is necessary to set up a procedure for maintaining the model. Physical conditions do change, and it is necessary to be in a position to determine when the deviation of actual observations from predicted values, indicates that the model is beginning to show signs of becoming obsolete. Arrangement should therefore be made to have the model checked periodically.

4.7 SUMMARY OF CHAPTER FOUR

The main issues discussed on this chapter can be summarised as follows:-

(a) Strategic planning is an analytical approach that encompasses an assessment of the future, the determination of desired goals in the context of the future, the development of alternative courses of action to achieve, those goals and the selection of courses of action from among those alternatives.

Nigerian University system witnessed tremendous changes over the years. Multi-campus systems evolved, enrolment grew rapidly, decay in the infrastructural facilities set in and funding from Government dwindled. These factors combined to make the future of the system more uncertain and requiring effective preparation of capital expenditure plans. Strategic planning is therefore expected to enable the Universities to stay oncourse and ensure maximum utilization of resources. New methods of planning therefore need to be evolved.

The NUC had since realised the importance of strategic planning to the sustainability of the University system and therefore formulated a policy directive towards achieving effective application of the concept. All the operational Departments except the Physical Planning

Department embarked on a pilot project towards improving the system as far back as 1987. It was only in 1995 that the Physical Planning started the current project on the development of funding model for allocating capital projects in the system as a strategic project.

Successful implementation of strategic planning requires accurate and timely information. The information must be based on accurate data from the Universities. A data collection strategy through the system of building survey became necessary. Three types of surveys namely, Structure, Dilapidation and Condition surveys were identified in the final analysis. It was concluded that a condition survey was more appropriate for this work and was therefore conducted. The condition survey involves physical inspection of each building with a view to assessing its maintenance requirement. The condition survey or process is to be conducted in three phases, in accordance with the methodology specified by the Literature review.

The Literature review on the condition of buildings in the Nigerian Universities revealed that most of the structures were in a dilapidated condition. Earlier on, some surveys were carried out in the Nigerian Universities in 1978 but it was in connection with the establishment of only the cost limit of some types of buildings. The condition survey process involves the physical inspection and grading the buildings, costing repair works and collating the necessary information for effective planning and execution of maintenance works. The global condition of all the buildings in each University will be used as a guide in prioritizing its maintenance works.

The conclusions from the condition survey was that data collected from all the Universities will be used to develop an equitable basis of capital funds allocation to the Universities according to their needs.

(b) A model has been defined as a symbolic representation of a system which expresses the contents of that system in terms of the factors which influence it. The significant items or components of capital projects identified in the University system include Students enrolment, Full Time Equivalent (FTE) Students, Usable space required per FTE student, the existing usable teaching and research spaces as well as the growth rates for the Universities. Using the factors, a weighted space concept was arrived at as a means of determining the relative space needs of different academic subjects.

The conceptual design of a cost model was similarly arrived at using variables which would allow analysis and predictions to be undertaken according to some changes.

Three different types of mathematical models were identified which include; the functional model, the control model and the predictive model. The predictive model was found to be most appropriate for the work and it was used. Furthermore, three different methods of building a mathematical model were recognised. These were; the empirical model, the regression model and the simulation model.

While the empirical model assumed that there is a fixed relationship between the design variables and cost, the reality is that in the construction sector where human performance is involved, exact relationships are not generally observed. Statistical relationships however, prevail and only average relationships may be observed. From the data collected therefore, an estimate of cost can be made which will allow cost prediction and forecasting, using a model.

Regression analysis is therefore a method whose estimates are made of the value of a variable (e.g. cost) from a knowledge of the value of one or more other variables. The relationship between two variables is described by computing a straight line through the data obtained, and represented as

$$y = a + bx$$

The problem of predicting what will happen in the future, especially in the developing countries such as Nigeria whose economy is solely dependent on unpredictable oil revenue made it imperative to adopt a better method of cost modelling, with regards to some items that are so uncertain, such as the maintenance work. A better approach to modelling in such situation is to define a likely range of values for the unit cost of an item and the likely range of inflation rate over a determined period of time. This is known as the simulation method of modelling and uses the concept of probability theory. The most famous of this method is the Monte Carlo simulation method. This method was considered most suitable for practical purposes in maintenance work estimation. With the help of powerful computers, the application of both Regression and Simulation methods have assumed wider dimensions. The two methods therefore provided the best predictions in cost modelling.

The conclusion drawn from the literature review on modelling was that cost of repairs and maintenance work can be estimated with a reasonable degree of accuracy. The estimated cost of repairs for the entire University system can be used to determine the total cost requirement for the system. Available funds can therefore be allocated on pro-rata basis in accordance with each Universities need.

The model developed can be used to test the Research Hypothesis which states that the "present method of capital fund allocation (using the generation of the Universities) is in equitable.

CHAPTER FIVE

5.0 DEVELOPING AN FTE WEIGHTED SPACE (INTERIM) MODEL USING DATA FROM SECONDARY SOURCES

5.1 PREAMBLE

The defunct Universities Grant Commission (UGC) in the United Kingdom introduced a new resource allocation methodology in the mid-1980s. The methodology involves the use of Teaching and Research components to serve as a basis of computing annual grant to the Universities (EM&A, 1999). Similarly, the Australian Government introduced the use of formula funding method to its Universities in 1989 (Taylor, 1991). The new policy directions adopted by these Countries were seen to be necessitated by the greater need for transparency and accountability in the use of public resources in their institutions. Most of the research publications have been on the allocation and utilization of recurrent grants in the Universities, with very little on the capital funds allocation. This is perhaps, with a view to avoiding problems in view of the widely held opinion that the characteristics of capital allocation and expenditure pattern can fluctuate from one year to another. Thus, making it difficult to predict (Bayenet, *et-al*, 1998).

The current reforms in the Nigerian University system initiated by the National Universities Commission are aimed at providing the necessary transparency, improving efficiency and ensuring equitable distribution of available resources among the Universities. The present study is one of such initiatives aimed at addressing the issue of equitable distribution of capital funds among the Federal Universities.

This Chapter critically examines the existing methods of capital grant allocation to the Universities by the National Universities Commission, analyses secondary data collected both in the United Kingdom and Nigeria and uses the data to develop and test an interim Model, using the concept of weighted space and the space requirement of Full Time Equivalent (FTE) student.

5.2 STRATEGIES OF DATA COLLECTION

The strategies of data collection and information gathering adopted for the purpose of developing an interim model as explained in Section 3.3. include:

I. Wide consultations involving series of unstructured interviews with Universities and Government officials in Dundee, St Andrews, Edinburgh and Nigeria.
II. Extensive literature review through the wide network of Library facilities in the United Kingdom, the Library facilities in Nigerian Universities as well as the Documentary Library of the National Universities Commission.
III. Holding regular project review meetings with the Supervisors.

A total of 9 (nine) official meetings were held in Scotland as follows:

University of Abertay Dundee; meeting with:

Assistant Principal, Finance and Administration

a. Deputy Finance Officer
b. Building Officer
c. Procurement Officer
d. Head of the Modular Scheme
e. Scottish Office, Common Services Agency, Edinburgh Senior Consultant
f. National Health Services Headquarters, Edinburgh, Management Executive - Estates Division

g. Scottish Higher Education Funding Council, Edinburgh, Head of Estate Management

h. University of St. Andrews, Secretary to the University.

Several meetings were also held with each of the Vice chancellors of Nigerian Universities under the National Universities Commission.

The information collected from the UK include:

1. The Standard Space norms as applicable in the UK institutions
2. The Scottish Education Funding Council (SHEFC) budgetary allocation procedure guide.
3. SHEFC procedure of monitoring capital projects.
4. National Health Services (NHS) procedure of monitoring capital projects.
5. The European Economic Community (EEC) procurement procedure guide.
6. Current policy on maintenance applicable to the Universities in the UK.

Similar documents were also collected from the Nigerian University system for a good comparison. The Nigerian University system has standard spaces per Full Time Equivalent (FTE) for each of the programmes (NUC Standard Guide, revised, 1994).

From the UK space norms concept as described by Touche Ross (1995), the standard space per FTE was used to compute the total weighted space factors for the Universities based on their FTE enrolment. Having obtained the total weighted spaces for the entire federal University system for the 1996/97 academic session, the information was used to re-allocate the 1996 capital grant to the Universities as a new model. This model was considered to be an interim model as it did not take care of other factors such as the building condition.

5.3 DATA PRESENTATION

5.3.1 Critical Appraisal of Existing Method of Allocating Capital Grants to the Federal Universities

Allocation of Capital grants to the Federal Universities in Nigeria is presently based on the years the Universities were established, known as the "generation concept". The Universities are then grouped into first, second, third and fourth generations respectively. The first generation group include all the Universities established between 1962-1970, the second include those Universities established in 1975, the third include all the Universities of Technology established in 1980 while the fourth group has the University of Abuja which was established in 1988.

The generation method of capital grant allocation allows all the Universities established within certain period of time to receive equal amounts of money for their capital projects each year. This method of capital fund allocation is being severely criticized because it ignores the differences that exist between the Universities in respect of:

(a) The number of students;
(b) The number and types of programmes offered;
(c) The special capital facilities required of some programmes;
(d) The number of physical facilities available to each University that need to be maintained; and
(e) The geographical location of the Universities.

Consequently, a more rational funding model would need to be developed which will take into account the student numbers and areas of study and which would enable an evaluation to be made of the equity of actual levels of funding to the various Universities.

5.3.2 Assessment of Total Cost of Rehabilitation/Replacement of Physical Facilities in Nigerian Federal Universities

The Cookey Report (1981) on Salaries and Condition of Services of University Staff recommended the conduct of an assessment in all the existing Universities to establish the total amount the Government would require to rehabilitate/replace dilapidated facilities in the University system.

The Physical Planning Department of the National Universities Commission conducted the assessment in 1982 with a view to advising Government on the necessary funds required for the purpose. A Team was constituted which visited all the existing Universities. A comprehensive report was prepared on all the facilities (NUC Rehabilitation Report, 1982).

The summary of the estimated cost required for space expansion due to the unexpected rise in students' enrolment, building repairs, provision of office equipment, repairs/replacement of office furniture, teaching as well as research equipment is shown on Table 5.1. The estimated cost was based on 1982 prices. The assessment conducted by the NUC officials did not investigate the condition of the building stock.

TABLE 5.1

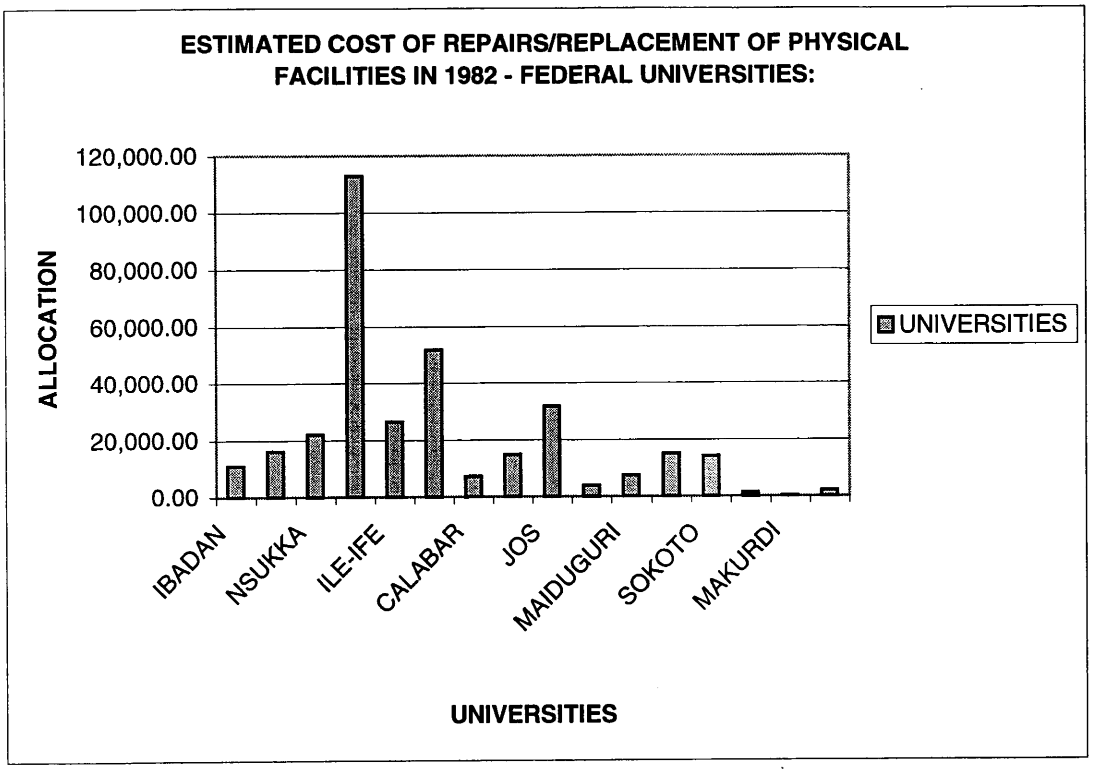
Estimated Cost of Repairs/Replacement of Physical Facilities in 1982 - Federal Universities:

a. Space expansion
b. Building repairs
c. Office equipment
d. Office furniture
e. Teaching equipment
f. Research equipment

S/N	UNIVERSITY	ESTIMATED TOTAL COST (₦) 000	Dollar Equivalent ($) 000
1	IBADAN	11,046.20	16486.86567
2	LAGOS	16,137.60	24085.97015
3	NSUKKA	22,127.40	33025.97015
4	AHMADU BELLO, ZARIA	113,015.80	168680.2985
5	ILE-IFE	26,597.70	39698.0597
6	BENIN	51,864.60	77409.85075
7	CALABAR	7,188.60	10729.25373
8	ILORIN	14,939.20	22297.31343
9	JOS	31,765.40	47411.04478
10	BAYERO, KANO	3,744.50	5588.80597
11	MAIDUGURI	7,361.70	10987.61194
12	PORT HARCOURT	15,102.00	22540.29851
13	SOKOTO	14,250.90	21,270.00
14	BAUCHI	1,276.20	1904.776119
15	MAKURDI	141.40	211.0447761
16	ADEYEMI COLLEGE OF EDUCATION, ONDO	2,085.00	3111.940299
	GRAND TOTAL	**₦338,644.20**	**$505,439.1045**

Source: NUC Physical Planning and Development Department

CHART 5.1



Similarly in 1990, the National Universities Commission conducted the first accreditation exercise of all the undergraduate programmes in Nigerian Universities. The exercise brought out the critical space shortages in the Federal Universities system as about 75% of the programmes could not be fully accredited due to deficiencies in physical facilities and staffing (NUCRHE, 1996 P.iii). Table 5.2, gives a breakdown of the estimated total cost of providing the space shortfalls in the Federal Universities in 1992.

TABLE 5.2

Financial Implications Of Accreditation Status Of Academic Programmes In Nigerian Universities Cost Of Providing Physical Facilities In 1992

S/N	UNIVERSITY	ESTIMATED TOTAL COST TO PROVIDE THE SPACE SHORTFALL (₦)	DOLLAR EQUIVALENT ($)
1	IBADAN	71,138,650.00	3600134.109
2	LAGOS	272,650,825.00	13798118.67
3	NSUKKA	336,068,260.00	17007503.04
4	ZARIA	66,243,575.00	3352407.642
5	ILE-IFE	217,671,055.00	11015741.65
6	BENIN	219,251,575.00	11095727.48
7	JOS	232,897,900.00	11786330.97
8	CALABAR	221,031,210.00	11185789.98
9	KANO	91,288,250.00	4619850.709
10	MAIDUGURI	183,004,150.00	9261343.623
11	SOKOTO	66,423,075.00	3361491.65
12	ILORIN	154,193,970.00	7803338.563
13	PORT HARCOURT	253,943,500.00	12851391.7
14	BAUCHI	85,863,235.00	4345305.415
15	MAKURDI	31,797,920.00	1609206.478
16	OWERRI	97,930,000.00	4955971.66
17	MINNA	53,522,600.00	2708633.603
18	AKURE	41,165,000.00	2083248.988
19	ABEOKUTA (No accreditation)	0.00	0.00
20	YOLA	26,453,000.00	1,338,714.575
21	ABUJA (No accreditation)	0.00	0.00
	GRAND TOTAL	**₦2,722,537,750.00**	**$137,780,250.51**

Source: NUC Department of Physical Planning and Development.

5.3.3 Standard Usable Space Per Full Time Equivalent (FTE) Student

The Standard Space Planning Guides currently in use by the University system in the United Kingdom and Nigeria were examined and evaluated.

The Standard Guide for Nigerian Universities, third edition (1994) recognises the Full Time Equivalent (FTE) student as a standard unit of measurement.

Departmental area is therefore obtained from the product of FTE student and usable area per student. A usable area is defined as the area provided exclusively for Teaching or research purposes measured from the inside face of the external walls and the centreline of partition walls. All stores, service rooms and workshops needed for academic (or primary use) rather than for general purpose uses are included in the usable area (NUC Guide, 1994b).

The mandatory areas as provided in the Standard guide are shown on Table 5.3. Using the FTE Standard norms, therefore, it is possible to calculate standard spaces for the various accommodations as shown on Tables 5.4, 5 .5 and 5.6.

TABLE 5.3

Mandatory Departmental Areas

S/No	DEPARTMENT	Usable Area Per FTE Student in Department (M 2/ FTE)
1	Veterinary	15.00
2	Agriculture	12.00
3	Forestry	12.00
4	Electrical Engineering (Base Unit 730m2)	+10.60
5	Civil Engineering (Base Unit 730m2)	+10.60
6	Mechanical Engineering (Base Unit 730m2)	+10.60
7	Production Engineering (Base Unit 730m2)	+10.60
8	Chemical Engineering (Base Unit 730m2)	+10.60
9	Architecture	9.50
10	Planning	9.50
11	Building	9.50
12	Biology	9.00
13	Botany	9.00
14	Zoology	9.00
15	Microbiology	9.00
16	Chemistry	9.00
17	Physics	9.00
18	Geology	9.00
19	Computer Science (Physical)	9.00
20	Biochemistry	9.00
21	Scientific Geography	8.30
22	Surveying	8.00
23	Archaeology	5.50
24	Education	5.50
25	Traditional Geography	5.50

26	Mathematics	4.00
27	Statistics	4.00
28	Computer Science (Statistical)	4.00
29	Languages	3.40
30	Social Psychology	3.40
31	Law	3.40
32	Accountancy	3.40
33	Management	3.40
34	Finance	3.40
35	Marketing	3.40
36	Theatre Arts (Base Unit 350m2)	+2.80
37	Music (Base Unit 350m2)	+2.80
38	Journalism	2.80
39	Classics	2.80
40	History	2.80
41	Religious Studies	2.80
42	Philosophy	2.80
43	Economics	2.80
44	Political Science	2.80
45	Sociology	2.80
46	Anthropology	2.80
47 - 68	Others	AD-HOC
	Lecture Theatres and Classrooms	
	Communal, Social and Service Building	
70	Library	1.25
71	Student/Computer Centre	0.76
72	Student Common rooms (Halls of Residence)	0.57
73	Dining	0.55
74	College Administration	0.20
75	Maintenance workshops	0.43
76	Central Administration	0.20

77	Staff Common Rooms	0.35
78	Shopping	0.25
79	Staff School	0.24
80	Large Hall	0.20
81	Indoors Sports	0.20
82	Central Storage	0.20
83	Auditorium	0.15
84	Conference Centre	0.10
85	Computer Centre	0.10
86	Audio-Visual Centre	0.06
87	Outdoor Theatre	0.04
88	Power Station	0.04
89	Central Laundry	0.03
90	Telephone Exchange	0.01
91	Health Centre	AD HOC
92	Religious Centres	AD HOC
93	Museum	AD HOC
94	Water Supply	AD HOC
95	Water Supply	AD HOC
96	Gatehouse and Security	AD HOC
97 -109	Others	AD HOC

5.4. DATA ANALYSIS

The Data collected from the Nigerian Universities for the 1996/97 FTE enrolments on Faculty-by-Faculty basis and their mandatory Departmental spaces per FTE were inputted into a Computer. Using the Lotus 123 Spreadsheet package, a detailed analysis of the data was conducted.

From Table 5.4, total FTE enrolment for all the Universities on the 13 disciplines was obtained, and it came to 268,886. Using the specified FTE space standard as specified on Table 5.3, the total weighted space factor as well as the grand total space factors were computed and are shown on Table 5.5. The grand total came to 2,299,922.8, the summary for each programme is provided on Table 5.6.

Using the capital grant allocation to the Federal Universities in 1996, a new allocation was made by the use of weighted space factor for each University. From Table 5.7 and B, the sub-total for each University generation was used.

The computation for each Generation was therefore conducted. For example, the computation for the first generation Universities was done as follows:

(a) No. of Universities = 6

(b) Names - UI, LAG, UNN, ABU, OAU, BEN

(c) Total FTE enrolment = 126,765

(d) Total weighted factors = 1,040,036.7

(e) Total allocation = ₦360,000,000 ($4,500,000.00)

Option 1

(a) The FTE allocation for UI was then computed as follows:

$$\frac{Total\ FTE\ weighted\ factor\ for\ UI}{Grand\ total\ FTE\ for\ the\ Universities} \times Total\ allocation\ for\ the\ first\ generation\ Universities$$

$$= \frac{157{,}826.6}{1{,}040{,}036.7} \times 360{,}000{,}000.00$$

$$= N\,\underline{\underline{54{,}630{,}356.8}}$$

Similarly, computations for all the Universities in the generation were undertaken using the same principle. Therefore, the amount for the different generation Universities was obtained. The result is given on Table 5.7 indicating that the peculiarity of each University was taken care of.

Table 5.7 goes further to show the percentage difference between the allocation by generation model and given by the FTE weighted model.

Option 2

In option 2, the principle used was the same but the grand totals were used instead. Example, for the University of Ibadan:

(a)	Total weighted space	=	157,826.6
(b)	Grand total weighted space	=	2,999,922.8
(c)	Grand total allocation ($16,478,975.00)	=	₦1,318,318,000

$$\begin{aligned} Allocation\ for\ UI &= \frac{157{,}826.6}{2{,}299{,}922.8} \times 1{,}318{,}318{,}000 \\ &= N\ \underline{\underline{90{,}466{,}361.6}} \end{aligned}$$

This allocation therefore did not observe the generation difference (Table 5.8) Computations for all the Universities were therefore done in the same manner and tabulated on Table 5.8. Chart 5.2 shows the 1996 capital grants based on the same principle.

The FTE weighted space model was considered to be an interim allocation since it did not take care of the condition of building stock in the Universities.

TABLE 5.4

Nigerian Federal Universities FTE Student Enrolment By Faculty And University 1996/97

FACULTY	ARTS	BUS. ADMIN	SOCIAL & MGT. SC.	SOCIAL SC.	LAW	EDUC.	AGRIC	ENG./ TECH.	ENV. SC.	MED. H. SC.	PHARM	NAT. SC.	VET. SC.	GEN. STUD.	TOTAL FTE
UI	2,503.0	0	0	3,438	401	2,602	1,481	1,228	0	2,859	237	4,145	423	65	19,382
LAG	1,305.0	2,399	0	2,798	1,075	1,355	0	1,990	1,168	1,552	188	3,339	0	0	17,169
UNN	1,449.0	1,840	0	1,816	639	2,688	1,787	1,615	1,204	2,737	831	3,406	930	0	20,942
ABU	4,167.0	5,434	0	0	1,421	4,858	918	2,720	1,179	1,558	1,141	2,628	594	2,860	29,478
OAU	1,965.0	2,309	0	1,993	1,078	2,146	1,217	3,415	1,827	1,332	601	2,872	0	0	20,755
BEN	1,616.0	0	2,509	0	933	1,609	1,236	1,919	0	1,687	606	5,918	0	1,006	19,039
JOS	1,462.0	0	0	3,181	642	778	0	0	1,752	508	363	2,698	0	950	12,334
CAL	1,792.0	0	0	2,966	664	1,165	1,105	0	0	1,580	0	6,428	0	0	15,700
KAN*	1,555.0	0	1,939	0	514	1,894	0	878	0	534	0	3,154	0	0	10,468
MAI	1,521.0	0	0	2,225	509	1,382	1,582	1,055	0	1,058	0	1,402	629	1,585	12,948
SOK	877.0	0	0	2,179	469	757	403	0	0	297	0	2,586	95	195	7,858
ILO*	1,752.0	0	3,102	0	432	2,859	855	2,262	0	1,413	0	3,894	0	0	16,569
PHR	1,339.0	1,358	0	1,400	0	3,525	0	1,671	0	1,443	0	2,339	0	0	13,075
UYO	1,992.0	1,427	0	0	389	897	878	70	171	0	1,773	4,536	0	1,200	13,333
AWK	1,671.0	1,420	0	0	559	781	0	860	0	660	0	2,353	0	0	8,304
ABJ	207.0	322	609	438	157	165	0	0	0	0	0	384	0	0	2,282
OWR	0.0	0	0	0	0	0	627	2,345	0	0	0	2,504	0	65	5,541
AKR	0.0	0	0	0	0	0	693	1,309	449	0	0	5,171	0	0	7,622
MIN	0.0	0	0	0	0	0	129	1,217	83	0	0	3,749	0	0	5,178
BAU	0.0	0	0	0	0	0	522	797	538	0	0	2,722	0	0	4,579
YOL	0.0	0	0	0	0	0	609	709	715	0	0	3,822	0	0	5,855
TOTAL	**27,173.0**	**16,509**	**8,159**	**22,434**	**9,882**	**29,461**	**14,042**	**26,060**	**9,086**	**19,218**	**5,740**	**70,050**	**2,671**	**7,926**	**268,411**

Note: * Headcount Enrolment

Source: NUC Abuja 1998

TABLE 5.5 Nigerian Federal Universities Weighted Space Per FTE Student Enrolment By Faculty And University 1996/97

FACULTY	ARTS	BUS. ADMIN	SOCIAL & MGT. SC.	SOCIAL SC.	LAW	EDUC.	MGT. TECH.	AGRIC.	ENG./ TECH.	ENV. SC.	MED. H. SC.	PHARM.	NAT. SC.	VET. SC.	GEN. STUD.	LIBR.	STUD./ COMP. CENTRE	TOTAL WEIGHTED SPACE PER
SPACE FTE PER m^2	2.8	3.4	2.8	2.8	3.4	5.5	10.6	12.0	10.6	9.5	2.8	2.8	9.0	15.0	2.8	1.3	0.8	
UI	7,358.4	0.0	0.0	9,626.4	1,363.4	14,311.0	0.0	17,772.0	15,936.8	0.0	8,005.2	663.6	37,305.0	6,345.0	182.0	24,227.5	14,730.3	157,826.6
LAG	3,654.0	8,156.6	0.0	7,834.4	3,655.0	7,452.5	0.0	0.0	24,014.0	11,096.0	4,345.6	526.4	30,051.0	0.0	0.0	21,461.3	13,048.4	135,295.2
UNN	4,757.2	6,256.0	0.0	5,084.8	2,172.6	14,784.0	0.0	21,444.0	20,039.0	11,438.0	7,663.6	2,326.8	30,654.0	13,950.0	0.0	26,177.5	15,915.9	182,663.4
ABU	11,667.6	18,475.6	0.0	0.0	4,831.4	26,719.0	0.0	11,016.0	31,752.0	11,200.5	4,362.4	3,194.8	23,652.0	8,910.0	8,008.0	36,847.5	22,403.3	223,040.1
OAU	6,202.0	7,850.6	0.0	5,580.4	3,665.2	11,803.0	0.0	14,604.0	39,119.0	17,356.5	3,729.6	1,682.8	25,848.0	0.0	0.0	25,943.8	15,773.8	179,158.7
BEN	4,874.8	0.0	7,025.2	0.0	3,172.2	8,849.5	0.0	14,832.0	22,531.4	0.0	4,723.6	1,696.8	53,262.0	0.0	2,816.8	23,798.8	14,469.6	162,052.7
JOS	4,443.6	0.0	0.0	8,906.8	2,182.8	4,279.0	0.0	0.0	0.0	16,644.0	1,422.4	1,016.4	24,282.0	0.0	2,660.0	15,417.5	9,373.8	90,628.3
CAL	5,367.6	0.0	0.0	8,304.8	2,257.6	6,407.5	0.0	13,260.0	0.0	0.0	4,424.0	0.0	57,852.0	0.0	0.0	19,625.0	11,932.0	129,430.5
KAN*	4,354.0	0.0	5,429.2	0.0	1,747.6	10,417.0	0.0	0.0	11,496.8	0.0	1,495.2	0.0	28,386.0	0.0	0.0	13,085.0	7,955.7	84,366.5
MAI	4,258.8	0.0	0.0	6,230.0	1,730.6	7,601.0	0.0	18,984.0	13,373.0	0.0	2,962.4	0.0	12,618.0	9,435.0	4,438.0	16,185.0	9,840.5	107,656.3
SOK	2,455.6	0.0	0.0	6,101.2	1,594.6	4,163.5	0.0	4,836.0	0.0	0.0	831.6	0.0	23,274.0	1,425.0	546.0	9,822.5	5,972.1	61,022.1
ILO*	5,255.6	0.0	8,685.6	0.0	1,468.8	15,724.5	0.0	10,260.0	26,167.2	0.0	3,956.4	0.0	35,046.0	0.0	0.0	20,711.3	12,592.4	139,867.8
PHR	3,749.2	4,617.2	0.0	3,920.0	0.0	19,387.5	0.0	0.0	19,902.6	0.0	4,040.4	0.0	21,051.0	0.0	0.0	16,343.8	9,937.0	102,948.7
UYO	6,277.6	4,851.8	0.0	0.0	1,322.6	4,933.5	0.0	10,536.0	742.0	1,624.5	0.0	4,964.4	40,824.0	0.0	3,360.0	16,666.3	10,133.1	106,235.7
AWK	4,678.8	4,828.0	0.0	0.0	1,900.6	4,295.5	0.0	0.0	11,306.0	0.0	1,848.0	0.0	21,177.0	0.0	0.0	10,380.0	6,311.0	66,724.9
ABJ	929.6	1,094.8	1,705.2	1,226.4	533.8	907.5	0.0	0.0	0.0	0.0	0.0	0.0	3,456.0	0.0	0.0	2,852.5	1,734.3	14,440.1
OWR	0.0	0.0	0.0	0.0	0.0	0.0	5,035.0	7,524.0	28,507.0	0.0	0.0	0.0	22,536.0	0.0	182.0	7,520.0	4,572.2	75,876.2
AKR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8,316.0	17,525.4	4,265.5	0.0	0.0	46,539.0	0.0	0.0	9,527.5	5,792.7	91,966.1
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,548.0	15,820.2	788.5	0.0	0.0	33,741.0	0.0	0.0	6,472.5	3,935.3	62,305.5
BAU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6,264.0	11,368.2	5,111.0	0.0	0.0	24,498.0	0.0	0.0	5,723.8	3,480.0	56,445.0
YOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7,308.0	9,705.4	6,792.5	0.0	0.0	34,398.0	0.0	0.0	7,318.8	4,449.8	69,972.5
TOTAL WEIGHTED SPACE/m2	**80,284.4**	**56,130.6**	**22,845.2**	**62,815.2**	**33,598.8**	**162,035.5**	**5,035.0**	**168,504.0**	**319,306.0**	**86,317.0**	**53,810.4**	**16,072.0**	**630,450.0**	**40,065.0**	**22,192.8**	**336,107.5**	**204,353.4**	**2,299,922.8**

Notes: 1.* Headcount Enrolment was used for KANO and ILORIN in lieu of FTE Enrolment.
The Following Base Units were added to the following Departments.
a. 730 m2 each to Electrical, Civil, Mechanical, Production and Chemical Engineering.
b. 350 m2 each to Theatre Arts and Music.

Source: NUC Abuja 1998

TABLE 5.6

Nigerian Federal Universities

Summary Of Weighted FTE Student Enrolment By Faculty 1996/97

FACULTY	TOTAL FTE ENROLMENT	SPACE FTE PER m2	TOTAL WEIGHTED SPACE/PER m^2
ARTS	27,173.0	2.8	80,284.4
ARTS & SOC. SCIENCE	0.0	2.8	0.0
BUSINESS ADMIN.	16,509.0	3.4	56,130.6
SOCIAL & MGT. SCIENCE	8,159.0	2.8	22,845.2
SOCIAL SCIENCES	22,434.0	2.8	62,815.2
LAW	9,882.0	3.4	33,598.8
EDUCATION	29,461.0	5.5	162,035.5
MGT. TECHNOLOGY	475.0	10.6	5,035.0
AGRICULTURE	14,042.0	12.0	168,504.0
ENGINEERING/TECH.	26,060.0	10.6	319,306.0
ENVIRONMENTAL SC.	9,086.0	9.5	86,317.0
MEDICINE/HEALTH SC.	19,218.0	2.8	53,810.4
DENTISTRY	0.0	2.8	0.0
PHARMACY	5,740.0	2.8	16,072.0
NATURAL SCIENCES	70,050.0	9.0	630,450.0
VETERINARY SCIENCE	2,671.0	15.0	40,065.0
GENERAL STUDIES	7,926.0	2.8	22,192.8
LIBRARY	268,886.0	1.25	336,107.5
STUD./COMPUTER CENTRE	268,886.0	0.76	204,353.4
TOTAL	**806,658.0**	-	**2,299,922.8**

Source: **NUC Abuja 1998, ₦80.00 = $1.0**

TABLE 5.7

Nigerian Federal Universities
Allocation Of 1996 Capital Grants Using Weighted Space Model
Option 1 (Observing Peculiarities In The Generation Of Universities With % Deviation)

UNIVERSITY	TOTAL FTE ENROLMENT	TOTAL WEIGHTED SPACE/M^2	ACTUAL ALLOCATION ₦	ALLOCATION USING WEIGHTED SPACE ₦	% DIFFERENCE IN ALLOCATION
UI	19,382.0	157,826.6	60,000,000.0	54,630,356.798	9.0
LAG	17,169.0	135,295.2	60,000,000.0	46,831,301.24.0	21.9
UNN	20,942.0	182,663.4	60,000,000.0	63,227,407.263	(5.4)
ABU	29,478.0	223,040.1	60,000,000.0	77,203,464.079	(29.0)
OAU	20,755.0	179,158.7	60,000,000.0	62,014,284.584	(3.4)
BEN	19,039.0	162,052.7	60,000,000.0	56,093,185.942	6.5
SUB TOTAL	126,765.0	1,040,036.7	360,000,000.0	359,999,990.5	
JOS	12,334.0	90,628.3	62,900,000.0	57,718,290.951	8.2
CAL	15,700.0	129,430.5	62,900,000.0	82,430,181.928	(31.0)
KAN	10,468.0	84,366.5	62,900,000.0	53,730,349.059	14.6
MAI	12,948.0	107,656.3	62,900,000.0	68,562,884.283	(9.0)
SOK	7,858.0	61,022.1	62,900,000.0	38,863,040.855	38.2
ILO	16,569.0	139,867.8	62,900,000.0	89,077,367.380	(42.0)
PHR	13,075.0	102,948.7	62,900,000.0	65,564,763.090	(4.2)
UYO	13,333.0	106,235.7	62,900,000.0	67,658,149.180	(7.6)
AWK	8,304.0	66,724.9	62,900,000.0	42,494,973.333	32.4
SUB TOTAL	110,589.0	888,880.8	566,100,000.0	566,100,000.0	
OWR	6,016.0	75,876.2	66,600,000.0	70,861,583.249	(6.4)
AKR	7,622.0	91,966.1	66,600,000.0	85,888,110.512	(29.0)
MIN	5,178.0	62,305.5	66,600,000.0	58,187,763.427	12.6
BAU	4,579.0	56,445.0	66,600,000.0	52,714,580.673	20.8
YOL	5,855.0	69,972.5	66,600,000.0	65,348,055.569	1.9
SUB TOTAL	29,250.0	356,565.2	333,000,000.0	333,000,000.0	
ABJ	2,282.0	14,440.1	59,218,000.0	59,218,000.0	1.9
TOTAL	**268,886.0**	**2,299,922.8**	**1,318,318,000.0**	**1,318,317,990.5**	

Source: **NUC Abuja 1998, ₦80.00 = $1.0**

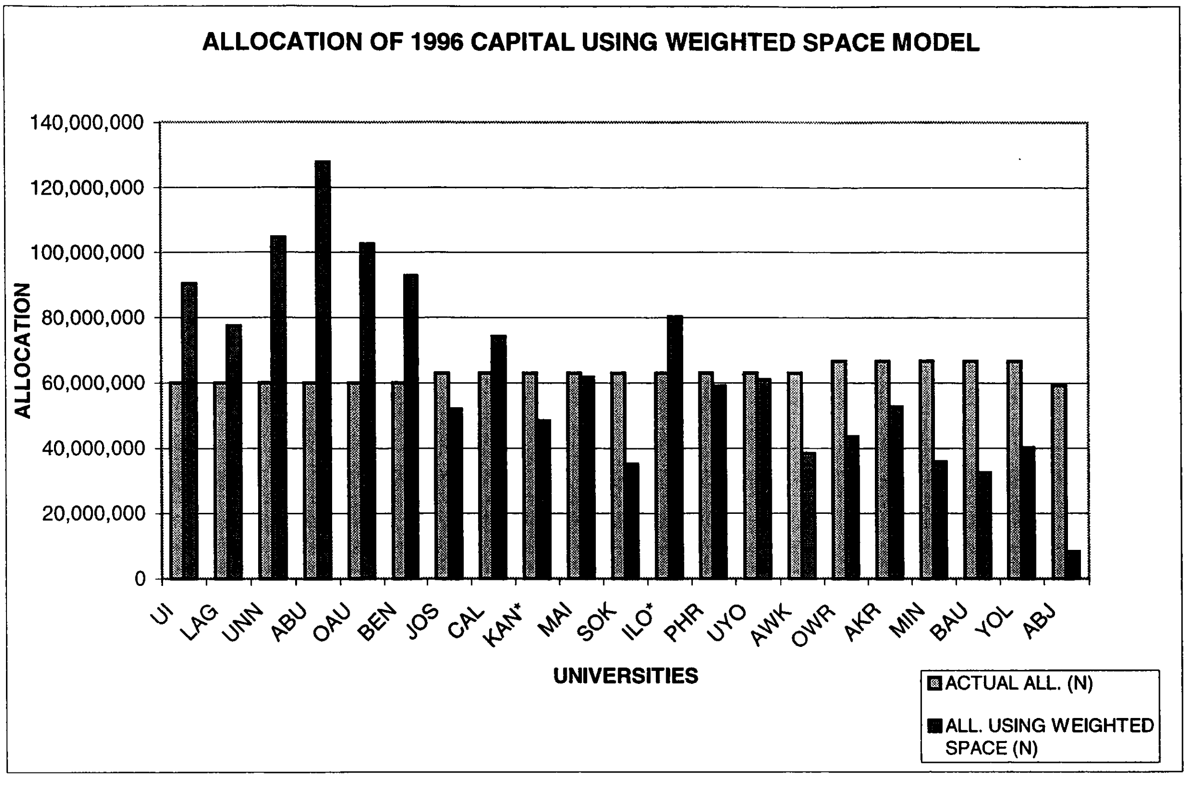
TABLE 5.8

Nigerian Federal Universities
Allocation Of 1996 Capital Grants Using Weighted Space Model
Option 2 (Not Observing Peculiarities In The Generation Of Universities)

UNIVERSITY	TOTAL FTE ENROLMENT	TOTAL WEIGHTED SPACE/m2	ACTUAL ALLOCATION ₦	ALLOCATION USING WEIGHTED SPACE ₦
UI	19,382.0	157,826.6	60,000,000.0	90,466,361.6
LAG	17,169.0	135,295.2	60,000,000.0	77,551,341.1
UNN	20,942.0	182,663.4	60,000,000.0	104,702,839.7
ABU	29,478.0	223,040.1	60,000,000.0	127,846,803.6
OAU	20,755.0	179,158.7	60,000,000.0	102,693,942.2
BEN	19,039.0	162,052.7	60,000,000.0	92,888,766.2
JOS	12,334.0	90,628.3	62,900,000.0	51,948,230.2
CAL	15,700.0	129,430.5	62,900,000.0	74,189,689.3
KAN*	10,468.0	84,366.5	62,900,000.0	48,358,960.4
MAI	12,948.0	107,656.3	62,900,000.0	61,708,696.5
SOK	7,858.0	61,022.1	62,900,000.0	34,977,927.4
ILO*	16,569.0	139,867.8	62,900,000.0	80,172,359.9
PHR	13,075.0	102,948.7	62,900,000.0	59,010,295.6
UYO	13,333.0	106,235.7	62,900,000.0	60,894,407.2
AWK	8,304.0	66,724.9	62,900,000.0	38,246,778.0
OWR	2,282.0	75,876.2	66,600,000.0	43,492,312.1
AKR	6,016.0	91,966.1	66,600,000.0	52,715,058.53
MIN	7,622.0	62,305.5	66,600,000.0	35,713,573.58
BAU	5,178.0	56,445.0	66,600,000.0	32,354,329.24
YOL	4,579.0	69,972.5	66,600,000.0	40,108,305.5
ABJ	5,855.0	14,440.1	59,218,000.0	8,277,079.5
TOTAL	**268,886.0**	**2,299,922.8**	**1,318,318,000.0**	**1,318,317,987.0**

Source: **NUC Abuja 1998, ₦80.00 = $1.0**

Chart 5.2



Source: **NUC Abuja 1998**

5.5. DISCUSSION: DEVELOPING THE INTERIM MODEL

5.5.1 Development of The Model

The FTE weighted model was developed using the idea of weighted space developed by the study group in the United Kingdom (Touche Ross, 1995).

The standard weighted spaces per FTE students in Nigeria was used to re-distribute the 1996 capital grant to the Federal Universities. The result indicates some level of inequitable distribution using the present method of Universities' year of establishment known as generation as a basis for distribution. Comparison between the present method and that provided by the FTE weighted model indicates that some Universities with less number of students received more funds than actually deserved. While others with more students like, ABU, Ilorin and Akure in each of the generation were disadvantaged by the uniform method of allocation (Chart 5.2). The highest shortfall to the affected Universities range from 28.7% for the first generation, 41.6% for second and 29.0% for the third generation respectively (Table 5.7).

The 1996 capital allocation was used for the FTE weighted Model in view of the following reasons:

a. The uniform formula for calculating Full Time Equivalent (FTE) in all the Federal Universities came into being after the study sponsored by the NUC in 1994 was approved and its application commenced in 1995.
b. The submission of data on FTE to the National Universities Commission based on the uniform formula started with the 1995/96 students enrolment.
c. It was considered logical to commence the use of weighted space Model for distributing capital grants with the 1996 capital allocation to coincide with the data on the uniformly calculated FTE for the 1996/97 academic session.
d. The 1996 budget provides a typical case if one considers the overall percentage of allocation to the Education in 1995, 1996 and 1997 as follows:

TABLE 5.9:

1996 Capital Allocation To Federal University System

YEAR	TOTAL FEDERAL BUDGET ALLOCATION TO BUDGET (CAPITAL) ₦	ALLOCATION TO EDUCATION SECTOR ₦		ALLOCATION TO UNIVERSITIES ₦	
	(1)	(2)	% of (1)	(3)	% of (2)
1995	44,500,000,000	3,017,901,040	6.78	1,518,000,000	50.30
1996	47,477,047,393	3,215,766,742	6.77	1,645,596,020	51.17
1997	83,000,000,000	3,807,000,000	4.59	1,295,919,239	34.04

Source: Annual budget breakdown, Federal Republic of Nigeria.

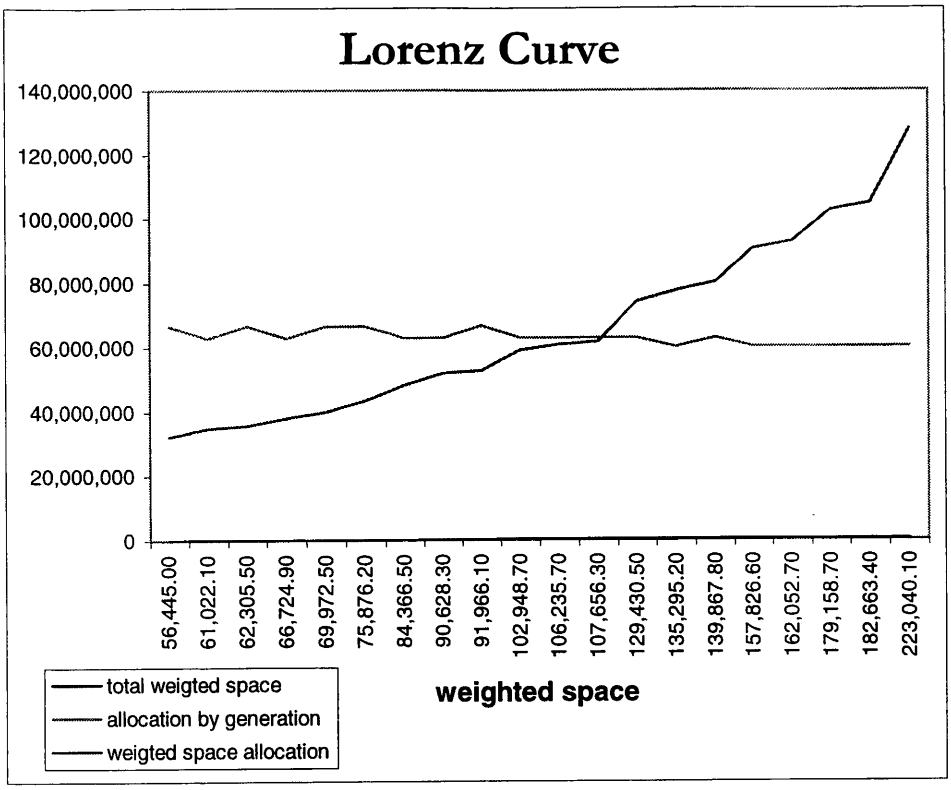
See appendix for dollar conversion

The concept of Full Time Equivalent (FTE) as a planning parameter which can be used for budgeting, space allocation, derivation of unit costs, derivation of excess work-load and in many other areas where there is a desire to allocate resources in relation to rational need became acceptable widely in 1996 after the issuance of a general guideline by the NUC in 1995. The same parameter is also being used to allocate recurrent grants by the NUC.

5.5.2 Validation of the FTE weighted Model

In order to justify the model scientifically, a statistical approach was adopted using the Lorenz graphical plot to display the level of equity. Geographers are usually interested in the distribution of some thing by size, e.g. output, income, etc. It is often important to know how far any of the distribution departs from one another or how much one distribution is more or less unequal to another. The measure of inequality is usually compared with the diagonal line called "trace line" which is a straight line passing through the origin at 45^0 to both the X and Y - axis (Toyn and Newby, 1971). Chart 5.3 is a plot of the two models, it shows the Lorenz plot indicating that the FTE Model provides more equitable distribution because it appears to be closer to the trace line.

CHART 5.3 **Lorenz Plot**



5.5.3. Testing The Model

(a) Effect of Sharp Difference between Previous Allocation

In order to counter the effect of sharp difference in allocation between what was obtained under the present method and what a University deserves under the weighted space model, a confidence interval was developed such that 95% of the Universities will fall within. The 95% confidence interval is defined by the formula

$$\mu \pm Z_{0.025}\sigma$$

where the upper bound is $\mu + Z_{0.025}\sigma$ and the lower bound $\mu - Z_{0.025}\sigma$

μ = mean,

σ = standard deviation and

$Z_{0.025} = 1.96$ = Standard normal value that guides 95% of the area of Standard normal distribution within it.

With mean = 62.78

and SD = 8.2

The upper bound = 62.78 + 1.96 (8.2)

= 78.92

and lower bound = 62.78 - 1.96 (8.2)

= 46.64

The upper with lower bound as calculated above are 78.92 and 46.64 respectively.

This was done such that no University should feel the effect of the change drastically. This type of adjustment was adopted in Czech Republic (Turner, 1994) known as safety netting where the effect of change arising from the introduction of formula funding was planned and phased over longer time span more than one year. Similar arrangement was also done in the UK by the SHEFC in allocating Equipment grant in 1995 where the weighting for computer technology was changed to 7 (SHEFC, 1995). In the Czech, it was decided that no institution should have a change of more than 10% whereas in our case, 5% was used. The choice of 5% in our case is to ensure that no University suffers drastic change from the experience of previous allocation.

(b) Differences Between The Space Model And The Generation Model

In order to justify further the difference between the FTE weighted Space Model and the present generation model, a non-parametric test called the Wilcoxon test was conducted.

Suppose two independent random samples are to be used to compare two populations, and the t-test is inappropriate for making the comparison, (that is the underlying probability cannot be assumed to be normal then the Wilcoxon test can be used to test the hypothesis that the Probabilities associated with the two populations are equivalent or not.

The Wilcoxon test, when conducted report the mean, number, standard deviation of each set of data as shown below for Allocation by generation and allocation using weighted space. The values for the two sets of data are ranked and the ranking compared. The mean rank for the cases where allocation by generation is greater than allocation using weighted space is given as 8.42. For the opposing case, the mean Rank is 13.63. If two-tail probability is given on the output to be 0.8813, which is less than the benchmark probability of 0.95 for which will be more evidence to support the alternative hypothesis. Hence with a probability of 0.8813 we have evidence to support the null hypothesis that there is no difference between the allocations by the two models. But it was earlier established that the weighted space model provides a more equitable distribution, as it traces the trace line of the Lorenz curve more, it is therefore believed to be a more equitable model than the generation model. The result from the test is on table 5.10

TABLE 5.10

Wilcoxon Test

01 Dec 99 SPSS for MS WINDOWS Release 6.0

	N	Mean	Std Dev	Minimum	Maximum
Allocation by generation	20	62955000.00	2501047.250	60000000	66600000
allocation using weighted space	20	65502044.00	27265520.00	32354324	1.28E+08

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

Allocation by generation with allocation using weighted space model

Mean Rank	Cases		
8.42	12	- Ranks (	Allocation by generation GT allocation using weighted space model)
13.63	8	+ Ranks (	Allocation by generation LT allocation using weighted space model)
	0	Ties (	Allocation by generation EQ allocation using weighted space model)
	20	Total	Z = -.1493 2-Tailed P = .8813

5.5.4 Compliance with Model's Theory

As the work begins to address the issue of parameters for allocation, it was ideal to test the level of compliance of the process so far with the conceptual design of model stages, enumerated earlier on.

At the analysis stages of the work, the problems of lack of transparent parameters that could be said to have formed the basis of capital grants allocation in the past were identified. Allocations were based on the year of establishing the Universities known as generation.

The synthesis stage could be identified as the developments of procedures to conduct a condition survey of existing Universities' buildings as a way of establishing reliable information system on capital projects in the Federal University system. The use of students enrolment, the full time equivalent (FTE) student space requirements for different programmes and the result of the condition survey for Teaching & Research spaces would form the basis of allocating capital grants to the Universities in future.

The appraisal stage is the use of Full Time Equivalent (FTE) student to evolve and test the effect of the allocation, using the 1996 Capital Grants for the Federal Universities. The stages followed therefore confirms the level of compliance with the theory of conceptual design of a Model.

5.5.5 Findings From the Initial Stages of the Study

The conclusions from the analysis of secondary data were as follows:

a. The current methods of capital funds allocation to the Nigerian Federal Universities did not reflect adequately the needs of the Universities in respect of the students numbers and areas of specialization.. Furthermore, no consideration was given to needs in terms of the adequacy of the building stocks and no data was available on the conditions of buildings in the various Universities, although it was known that lack of maintenance had resulted in buildings becoming unusable. It was clear that the model in the final stages of the work would require to include the funding necessary to maximise the usable building stock.

b. Appropriate methods of monitoring capital expenditure were in place but greater emphasis needed to be placed on ensuring adherence to these procedures. The strengthening of central control over the capital expenditure would have to form an important aspect of the methodology that would be adopted to implement the expenditure patterns produced by the cost allocation model.

c. The FTE weighted space model is capable of being reviewed every year as the new FTE enrolment data become available. This therefore conforms with the requirement of good cost model as identified by Ashworth (1988).

d. Finally, the FTE weighted model provides more money to those Universities with more FTE students' enrolment. This further gives support to Uvah (1999), which states that virtually all formulae driven allocation models assume a linear relationship between enrolment and costs.

e. The FTE weighted space model has therefore proved the hypothesis that the present method of capital fund allocation using the generation as a base is inequitable to most Universities.

CHAPTER SIX

6.0 DEVELOPMENT OF CAPITAL FUND ALLOCATION MODEL, USING DATA FROM PRIMARY SOURCES

6.1 PREAMBLE

The demand for rationality in the allocation of resources and for strengthening of the planning process has placed emphasis on the need to provide consistent data for decision making at a strategic, tactical and operational levels. Formulaic approaches to resource allocation are therefore seen as a contribution to that process. In the previous chapter, an FTE weighted space (interim) model was developed using two variables, the Full Time Equivalent (FTE) student enrolment, and the standard space/FTE student. Although the interim model provides a more equitable basis of capital funds allocation than the generation model, it did not take into consideration the existing building conditions and other parameters that are vital to the maximization of the use of existing building stock.

This chapter describes the process of collecting the primary data and their analytical processes. It describes the process of developing and testing of a general linear model and its applications, using multiple linear regression method. In the Construction Industry, regression techniques have often been used to model and forecast construction variables such as demand and price, in view of their relative simplicity on both concept and application. Bee-Hua (1999) summarised previous research works on the application of multiple regression approach in forecasting variables in the Construction Industry. Similarly, Mogbo (1999) used regression variables in the Nigeria's Federal budget. However, all the works appear to have concentrated on forecasting variables for new building projects. Little attention was therefore paid to the application of the regression method in the area of maintenance planning. In the area of capital fund allocation, there is no research work on the application of the concept in funding Nigerian University system. This chapter uses the multiple linear regression approach in stepwise method to arrive at an acceptable model with R^2 value of 81.55% which is considered reasonable for practical use.

The chapter also describes the various statistical verification methods needed to validate the new model.

6.2 DATA COLLECTION AND ANALYSIS

6.2.1 Phased Data Collection Strategies from the Primary Sources

(a) **Introduction**

Data collection from the primary sources is the most important component of the entire work.

The literature review has established that in trying to create information system for physical development in the University system, the first thing is to assess the condition of existing buildings and other facilities. The assessment of existing facilities and evaluation of their present use would enable a database to be created which will bring all the information together for management decision making. BMI Special Report (1995) classified the levels of decision making, namely the strategic policy decision making and operational policy decision making. The literature review supported the conclusion that this research which is aimed at strategic policy decision making would require only soundly broad based knowledge of the condition of buildings across the Universities. For this purpose also, the review supported the conclusion that only a condition priority need to be established for the existing building stock in order to help the Universities prioritize the execution of their projects in accordance with the available resources and immediate need.

Earlier studies (Cookey Report , 1981, Longe Report, 1992 and Ndayako Report, 1997) had established and supported the need for a comprehensive assessment (Survey) of existing properties in Nigerian Universities in order to assist in Planned Maintenance Strategies.

Furthermore, the Literature review has indicated that there is some relationship between age of the building and maintenance costs (Ashworth, 1988). The review therefore supported the need to assess the condition of existing building stock and to estimate the total cost required to restore each building into its functional position. The estimated total cost of repairs in each University is expected to provide the institution's total need. Having computed the total need of the system, available Capital funds can then be allocated according to the need of each University.

(a) **The Data Collection Phases**

Three distinct phases were identified by the literature review in the process of conducting a condition survey or assessment (BMI Special Report, 1995). These phases include:

(i) Phase I, which involves the setting out of the scope and content of the survey, selecting the survey team, preparation of action plan for the work as well as briefing and training of the team on how best to handle the survey.

(ii) Phase II, which involves the actual collection of the data specified in the first phase, and

(iii) Phase III, which involves validation and the application of the data.

The data collection for this work was particularly divided into functional phases in view of:

a. The need to have authentic data from the Universities that will be used in building a reliable database.
b. The need to ensure that the respondent Universities are not stressed by

requesting for too much information that would discourage the Universities from responding or ensuring that accurate data are provided.

c. The need to progressively input the data into the computer as the data arrive in order to avoid missing vital information and to facilitate the analysis.

(c) **Phase One of the Data Collection**

The literature review has identified the level of information required for the strategic policy decision making. During the Phase I aspect of the data collection, the scope of the condition survey to be carried out was defined. This involved the collection of data on a broad base condition of the existing building stock in the Federal Universities.

(i) **Selecting the Survey Team**

Having appreciated the need for high quality data for this work, the use of qualified Surveyors became necessary. The staff of Physical Planning and Development (PPD) Department of the NUC were therefore identified for the survey. The staff comprise of Engineers, Quantity Surveyors, Architects as well as Urban and Regional Planners. The NUC approved the request made by the Researcher to employ the services of all the professional staff of the PPD for the survey. Four groups were therefore formed to handle the Universities as follows:

Group 1: Universities in the North-West zone

Group 2: Universities in the North-East zone

Group 3: Universities in the South-East zone

Group 4: Universities in the South-West zone

At the University level, the staff of the Physical Planing Unit, directly under the Office of the Vice Chancellors were identified for the survey in their Universities. Having selected the Team for the survey, the Researcher embarked on series of training programmes in the form of Seminars, Workshops and Departmental meetings for both the NUC and Universities' staff participating in the survey.

(ii) Development of Data Collection Strategies

Having identified and selected the Teams, a comprehensive data collection strategy was then developed. Discussion on the data collection strategies started during the full time study period in 1995 at the University of Abertay, Dundee. Several meetings were held with Dr. David Blackwood and Mr. W.B. Crabb while in Scotland and with Professor E.A. Adeyemi in Nigeria after returning in 1996. The summary of the data collection strategies is as follows:

(a) Conducting series of extensive training programmes for both the Researcher and the Universities' officials that handled and administered the data collection instrument (Questionnaires);

(b) Adopting the use of most effective data collection instrument for the work;

(c) Carrying out the data collection in functional phases that would allow ease of data entry and processing;

(d) A total period of twenty-one months was earmarked for the data collection in three phases.

(iii) Training the Team

After the selection, series of training programmes were conducted both in house and at the national level. The Researcher attended some Conferences where ideas were shared with foreign Consultants on similar issues. Six external programmes were conducted in addition to several in-house and departmental seminars. In order to ensure success of the data collection exercise in general and the training programme in particular, the Executive Secretary of the National Universities Commission sent a circular letter to all the Federal Universities informing them about the project and requesting them to cooperate and give all the relevant data required. The message was conveyed to the Vice Chancellors vide a letter referenced NUC/ES/216/VOL.XVIII/189 dated 11th May, 1996 (Appendix II).

The letter was followed by the external training programmes. A summary of the external programmes is as follows:

1. The Petroleum (Special) Trust Funds (PTF) organized workshop on rehabilitation of dilapidated buildings and engineering infrastructure held between August, 28th - 29th 1996 at the University of Lagos, Nigeria.

   The Nigerian construction professionals and Universities' officers in charge of Physical Development attended the workshop. During this workshop the concept of conducting condition survey of dilapidated buildings and other infrastructure in order to prepare comprehensive tender documents for rehabilitation works was extensively discussed and the participants fully educated on how to execute it.

   It was a great opportunity for the Researcher to explain the proposed data collection strategy to the Universities' officials.

2. The NUC, Universities and the PTF workshop - 26th September, 1996 at the NUC Secretariat, Abuja, Nigeria.

   Following the success recorded at the Lagos workshop, which was for all the sectors in the economy, the National Universities Commission on the recommendation of the Researcher organized a similar workshop at the NUC headquarters in Abuja but this time strictly for the University sector officials only. At the workshop, the concept of the condition survey was fully explained to the Universities officials and extensive deliberations were conducted.

   The officers left fully prepared to carry out the condition survey of existing buildings and infrastructure on the campuses.

3. National Seminar on contract administration and management of rehabilitation projects in Nigeria, 20th - 21st March, 1997, Lagos, Nigeria.

   This was a two-day seminar on the administration and management of rehabilitation projects held at the University of Lagos. Extensive discussions were held and ideas shared with the participants.

4. Workshop on Management Information System (MIS) and project management held at the University of Ibadan, Nigeria, between 9th - 12th

April, 1997.

This was an extensive workshop and the deliberations were quite fruitful to the project in general and data collection and analysis in particular.

5. 1997 Technology Summit for sustainable National Development, 18th - 22nd May, 1997, Abuja, Nigeria.

   Another very important summit was attended in which extensive ideas were developed on how best to maintain, and plan for Nigeria's future development as it affects technology. The outcome of the summit was of tremendous benefit to the Project.

6. National Conference on Water Sector Reforms:

   Policy options for private sector participation in water and Sanitation Sector, 17th - 19th June, 1997.

   The current economic situation in the Country is forcing government to think of alternative methods of funding social services like water and education. The conference was jointly organised by the World Bank in order to encourage private investors to participate in the provision of water supply and sanitation services.

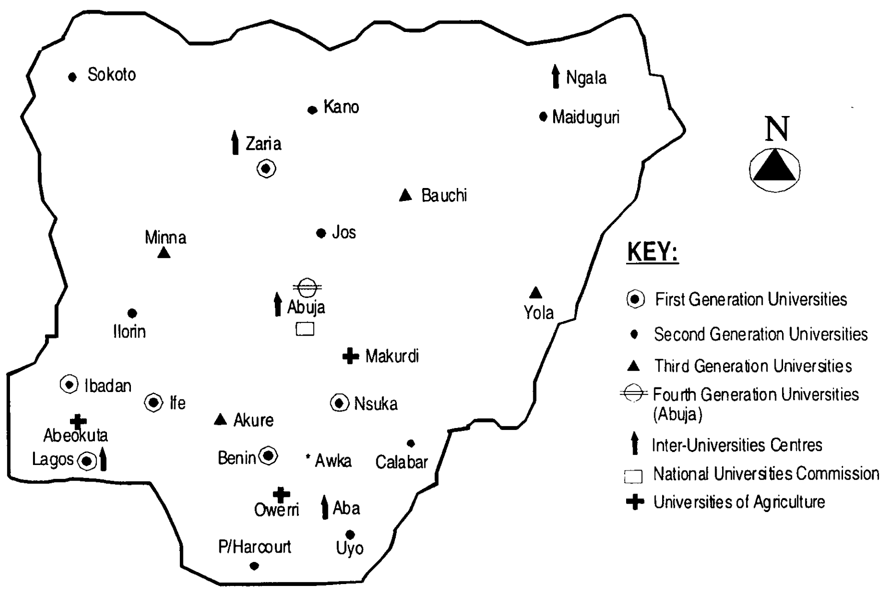
   It was a unique opportunity for the Researcher to share his experience with some International Consultants with world-wide experience in the provision of social services.

In addition to these conferences, several departmental seminars were held during which the survey teams were fully briefed on the method of conducting the data collection exercise.

iv Selecting Instrument for the Data Collection

Nigeria is a very large Country with a total land area of approximately 923,768.64 square kilometres. It has various climatic zones from the thick rain forest in the extreme south to the Sahara desert in the extreme northern part of the Country. The Federal Universities are located all over the Country across the climatic zones as shown in plate 6.1

PLATE 6.1 Locations of Federally Funded University Institutions in Nigeria



After considering all the possible data collection instruments as explained in Chapter 1, the use of Questionnaires and Structured interviews with key Government officials were found more appropriate.

In view of the widespread location of the Federal Universities in Nigeria as shown in Plate 6.1, a postal survey was considered more economical for the research work and was therefore adopted. Mangione (1995) identified nine criteria in support of choosing a postal survey for a research. These included the situation where:

a) the research sample is widely distributed geographically;
b) the research budget is modest;
c) there is limited person-power to help conduct the study;
d) research subjects require time to consider their responses;
e) questions can be written in a closed end style;
f) the sample are likely to have an investment in the topic;
g) the list of research objectives is modest in length;

h) research subjects require privacy in formulating the response; and
i) questions are more appropriate in the visual rather than oral mode.

The proposed method of data collection through the condition survey met all the criteria, and a postal survey was found most attractive and was therefore used. The major disadvantage of postal survey being the issue of non-respondent as identified by Miller (1991) was taken care of by the NUC Executive Secretary's letter to the Vice Chancellors (Appendix II) and the regular monthly visit to the Universities by the NUC Project Officers who formed the survey team. Sample of the questionnaires are shown in Appendix III.

(v) **Instrument for Verifying the Data Collected**

In order to ensure the integrity of the data collected, a verification certificate was designed which was signed by Senior officials of the sampled Universities to authenticate the data from each Institution. Sample of the verification certificate is shown in Appendix IV.

6.2.2 Phase Two of the Data Collection - Primary Data on Existing Physical Facilities

The questionnaires requesting information on Nigerian Universities' infrastructure were sent out in April, 1997. The second questionnaires were sent out in May, 1997 asking the Universities to provide information on their building stocks. The general circular was sent out on 12th May, 1997, Ref. No. NUC/PPD/A.200 and was titled Inventory of Physical facilities in Nigerian Federal Universities (Appendix V). This was the first part of the phased condition survey data collection strategy. The information requested in a tabular form include:

1. Serial number of the building.
2. Name of the building.
3. Faculty in which the building is located.

4. Block number within the Faculty.
5. Total number of separate blocks attached to the building.
6. Usable floor area for the Faculty.
7. Year of commissioning the building.
8. Last date of renovating the building.

The general circular on the second phase which involved carrying out the condition survey was sent out on 27th June, 1997 (a copy of it is shown in Appendix VI). The circular was sent out after holding technical seminar in the NUC Physical Planning Department during which the staff were trained (see Appendix VII).

The requirement this time was to grade the building stock in accordance with the guidelines provided. The Universities were also expected to provide the cost estimate (to serve as guide) for the rehabilitation of the buildings. A typical return from the Universities is shown in Appendix VIII.

6.2.3 Sample Population

Overall, there are twenty-four Federal Universities in Nigeria. Three of the Universities (Abeokuta, Makurdi and Umudike) are specialised Universities of Agriculture and are therefore under the Federal Ministry of Agriculture, leaving only twenty one (21) to be directly under the supervision of the National Universities Commission. In order to facilitate generalisation of result and to ensure Universality of the model, a stratified sampling strategy was used to collect the data. Ezejalue, et-al (1990) explained that in a stratified sampling, the parent population (the total number of Universities is again divided into mutually exclusive and exhaustive subsets (e.g. the generation group of the Universities). A random sample of these subsets was then selected probabilistically.

The questionnaires were delivered to all the Universities and monthly follow up of responses were made by the National Universities Commission Project Officers. At the end of the second phase of the data collection period, data from twelve Universities were found complete for the analysis. This gives approximately 52.3% response rate which was considered reasonable for the research.

The data that was finally cleaned and used, came from the following Universities:

(a) ***First generation Universities***

1. Benin
2. Ibadan
3. Zaria

(b) ***Second Generation Universities***

1. Calabar
2. Jos
3. Ilorin
4. Sokoto

(c) ***Third Generation Universities***

1. Akure
2. Bauchi
3. Minna
4. Yola

The data used provide a representative sample from each of the groups. In the first generation group, three Universities were used out of a total of six Universities, giving a 50% selection. Similarly, four out of the seven Universities in the second generation group were used giving a 57.1% selection. Finally, four out of the five third generation group were used giving a 80% selection for the group.The table below is a contingency table of population and sample figures.

TABLE 6.1 (a): Population Sample Figures

Generation	Number selected	Number not selected	Total
First gen	3	3	6
Second gen	4	3	7
Third gen	4	1	5
Total	11	7	18

Since there are 6 first generation university in the population of 18 we expect this same proportion in the sample. The expected value for each cell in the population is computed as follows:

*Expected cell value = (corresponding cell row total * corresponding cell column total)/overall total*

eg Expected value (first gen) = (6*11)/18 = 3.6667 as shown in the table below.

A goodness of fit test was hence conducted as in the table below.

TABLE 6.1 (b): Goodness of fit test

Generation	**Observed**	**Expected**	**Chi-Square Value**
First	3	3.6667	0.121212
Second	4	4.27778	0.018038
Third	4	3.05556	0.291919
Total	11	11	0.431169

The • ^{2} value is used to measure the difference between the observed value and the expected value for a population distribution. This measure is often used on a sample to show that the sample is a fair representation of the population.

The value is computed as follows:

$$\chi = \frac{(0-E)^2}{0}$$

Where 0 = observed value

E = Expected value

Table 6.1 shows the observed value from the sample, the expected value from the population and П2- value. The total of П2- value is compared to a table value П2(a-1) (b-1) with (a-1) (b-1) degree of freedom where *a* is the number of columns and *b*- is number of rows.

The chi-squared value from table is 5.999 (with 2 degree of freedom) and the total chi-squared value calculated is .431169. Since the calculated value is less than the chi-squared value from the table (within the range of 0.103 - 7.318) we conclude that the observed is not very different from the expected. Hence we conclude that the sample is a representative of the generation split at $p > 0.05$ and П2-value = 0.4312. Therefore the sample is a true representation of the population. The data collected were then progressively stored into the computer for analysis

6.2.4 Data Entry into the Computer

A computer database was created using Dbase IV software. Data collected from the sampled Universities were progressively entered and stored into the computer as they arrived. This method eliminated the possibility of missing data from any of the sample Universities.

The collected data were coded in the computer for ease of processing. A Microsoft Excel Spreadsheet version 97 systems, a Statistical Package for Social Science (SPSS) version 6.0 software and a Mini Tab Package version 12.0 were used for the analysis.

(a) **University Code** A uniform coding that indicates the generation of the University was adopted for ease of the work. Example, 011 was given to University of Ibadan being the first University as follows:

001 First generation University

010 indicating the first University (Ibadan)

Details of the coding are shown in Appendix IX. Similarly, the Faculties were coded to indicate the various Faculties and Centres.

6.2.5 Data Cleaning

The data from the sampled Universities were first carefully checked for accuracy. Some data entry errors were noted and corrected by considering 1998 figures. Preliminary data analysis showed that the reading from Federal University of Technology, Owerri did not contain any estimated cost. Data from the Federal University of Technology, Owerri was therefore excluded from the analysis. Further analysis revealed that there were five buildings with conditions nine (9). Two of these buildings had estimated costs with approximately three times larger than the next most expensive cost. This finding added weight to the earlier decision to exclude building in this category. Building in condition 9 were classified as those structures that were never completed and put to use. The buildings including their estimated cost of completion were found to have the potential of distorting the final result, as such, a decision was reached with the Supervisors (Dr. Staines and Prof. Adeyemi) to eliminate the group.

6.2.6 Phase Three of the Data Collection - Data Verification

Each of the sampled Universities was given a verification certificate and copy of the processed data for the University as captured from its submission. The University was requested to check the processed data to confirm or amend as necessary. All the sampled Universities responded and signed the certificates before the analysis commenced.

(a) **Pilot Study**

A pilot study was first conducted by administering the questionnaires on three Universities only. These Universities were Ahmadu Bello University, Zaria (1st generation University), the University of Calabar (2nd generation) and the Federal University of Technology, Akure. The initial difficulties of classification of building grades and putting appropriate Faculty classifications were identified and corrected.

(a) **Spot Checks by the Researcher**

In addition to participating personally as the Leader of the Group in charge of the South-West, spot checks on the Surveyors and the Universities were conducted by the Researcher. At the end of the second phase of the data collection exercise, all the eleven sampled Universities were visited by the Researcher. These visits helped in streamlining issues as problems arising either as a result of classification of buildings or grouping of buildings' conditions were solved on the spot. Most of the problems had to do with classification of the building grades.

The training programmes conducted initially were discovered to have contributed immensely in making the data collection a success. Officers were discovered to be fully aware of the procedures and grading methods of the condition survey.

A monthly technical preview meetings was held with the NUC officers after their visit to the Universities. The meetings assisted in solving problems on a regular basis.

6.2.7 Presentation of Analysed Data

(a) Frequency

A frequency table is a statistical table that compares the frequencies for samples drawn from different groups.

The frequency table below shows the count of condition of building for all the Universities.

TABLE 6.2 Frequency of the Buildings' Condition

Condition	Frequency	Percentage	Cumulative Percentage
1	57	7	7
2	141	18	25
3.	203	26	51
4	138	17	68
5	107	13	81
6	32	4	85
7	34	4	89
8	3	1	1
In-complete	82	10	10
	797	100	100

The frequency table shows that about 26% of all the 797 buildings in the data are classified as 3 or 3rd grade buildings. About 51% of the total building stocks are within conditions 1-3.

(a) BUILDING AGE

The variable *age of building* was grouped as follows in table 5.3 below.

TABLE 6.3: BUILDING AGE

Group	Frequency	Percent	Cumulative Percentage
0 –10	107	13	13
11 – 20	195	24	37
21 – 30	156	20	57
31 – 40	165	21	78
41 – 50	65	8	86
In-complete	114	14	100
	802	100	100

Of the 802 buildings about 24% are aged between 11 - 20 years. While about 57% of all the buildings are within the age of 30 years. The frequency tables for condition of building for different generations of Universities were also developed.

Computation of Mean and Standard Deviation;

To compute the mean, the following formula was used:

$$\bar{x} = \frac{\sum_{i=1}^{N} x_i}{N}$$

where:

x_i = Condition of the building i

N = Size

The Standard Deviation

To compute the standard deviation, the following formula was used to compute the variance first which is given as:

$$Var = \frac{\sum_{i=1}^{N} \left(x_{\_} - \bar{x}\right)^2}{(N-1)}$$

$$but\ \bar{x} = \frac{\sum_{i=1}^{N} x_i}{N}$$

$$\therefore\ Var = \frac{N\sum_{i=1}^{N} x_i^2 - \left(\sum_{i=1}^{N} x_x\right)^2}{N(N-1)}$$

The standard deviation is the square root of the variance:

$$S = \underline{\underline{\sqrt{Var}}}$$

Using the data in table 6.4 as an example, the following results for the mean and standard deviation were obtained. However, buildings with incomplete records were not considered.

X	Freq (f)	x * f	$(x^*f)^2$
1	8	8	8
2	42	84	168
3	61	183	549
4	53	212	848
5	72	360	1800
6	31	186	1116
7	33	231	1617
8	1	8	64
	N = 301	**1272**	**6170**

$$\bar{x} = \frac{1272}{301}$$
$$= \underline{\underline{4.23}}$$

$$Var = \frac{(301 \times 6170) - (1272 \times 1272)}{301 \times (301 - 1)}$$
$$= 2.64893$$
$$\therefore S = \sqrt{264893}$$
$$= \underline{\underline{1.627511}}$$

Table 6.4 shows the frequency table for condition of building for the first generation Universities.

TABLE 6.4: COND97 Condition Of Building 97 For First Generation Universities

Condition	Frequency	Percentage	Cumulative Percentage
1	8	3	3
2	42	14	17
3	61	20	37
4	53	17	54
5	72	24	78
6	31	10	88
7	33	11	99
8	1	1	-
Incomplete	4	1	100
Total	305	100	100

Mean =4.23 standard deviation =1.63

The average condition of building for First Generation University is 4.26, while 24% of these buildings are in condition 5. Up to 78% of the building stock are within condition 1-5.

Table 6.5 shows the frequency distribution for second generation Universities

Table 6.5: COND97 Condition of building 97 for second generation universities

Value	Frequency	Percent	Cumulative Percentage
1	18	15	15
2	11	9	24
3	44	35	59
4	25	20	79
5	19	15	94
8	2	1	96
Incomplete	5	4	100
Total	124	100	100

Mean = 3.2 Standard deviation =1.39

The average condition of building for second generation University is 3.2 while about 35% of these buildings are in condition 3. Comparing Table 5.4 with Table 5.5 shows that second generation buildings are of better condition than first generation building. This trend supports the age factor as first generation University buildings are older than second generation University buildings.

The third generation University buildings are of even better condition than second generation University buildings as shown in the table. The mean condition for third generation University building is 2.15 as shown on table 6.6. Data from the third generation contains many incomplete items the stepwise method did not consider them. The reason for the large number of incomplete items, was discovered to be as a result of the fact that most third generation are still on temporary campuses with inherited buildings whose records were difficult to trace.

Table 6.6: Cond97 Condition of building 97 for third generation universities

Condition	Frequency	Percentage	Cumulative Percentage
1	7	3	3
2	27	12	15
3	14	6	21
Incomplete	182	79	100
Total	230	100.0	100

Mean=2.146 and Standard deviation = 0.652

The same trend was observed when counting the grouped age within the different generations. On average, first generation buildings are older than second generation buildings. The mean age for first generation University building was 3.2 (labelled 21 - 30 years), for second generation University it was 2.372 (labelled 11 - 20) and for third generation it was 1.322 (labelled 0 -10 years).

Table 6.7: GRADE GROUPED AGE FIRST GENERATION

Value Label	Value	Frequency	Percent	Cumulative Percent
0-10	1.00	20	7	7
11-20	2.00	58	19	26
21-30	3.00	74	24	50
31-40	4.00	95	31	81
41-50	5.00	43	14	95
Incomplete		17	5	100
	Total	307	100.0	100

Mean =3.286 and Standard deviation=1.149

Table 6.8: GRADE GROUPED AGE SECOND GENERATION

Value Label	Value	Frequency	Percent	Cumulative Percent
0-10 YEARS	1.00	16	13	13
11-20 YEARS	2.00	22	18	31
21-30 YEARS	3.00	48	39	70
Incomplete	.	38	30	100
	Total	124	100.0	100

Mean=2.372 and Standard deviation = 0.783

Table 6.9: GRADE GROUPED AGE THIRD GENERATION

Value Label	Value	Frequency	Percent	Cumulative Percent
0-10 YEARS	1.00	135	59	59
11-20 YEARS	2.00	64	28	87
Incomplete		31	13	100
	Total	230	100.0	100

Mean=1.322 and Standard deviation = 0.468

(c) UNIVERSITY SUMMARIES

More specific summary for individual University is given below in table 5.10, together with the means and some variables of "age", "condition of building", "Estimated cost of repair" floor area", and "number of blocks for each unit.

Table 6.10: MEANS OF SOME VARIABLES

University	Uni. Code	Age Mean	Condition Of building 97 Mean	Estimated Cost of Repair Mean	Floor Area Mean	Estimated Cost 97 Sum	Floor area Sum	Block Number Sum
UI	11	37.63	3	8,067,391.00	3,521.12	556,650,000.00	242,956.94	813.00
UNN	31	30.91	5	18,292,517.00	2,153.66	2,689,000,000.00	316,588.22	3,344.00
ABU	41	29.80	3	3,750,594.00	3,030.20	547,586,729.00	454,529.88	1,516.00
BEN	61	16.78	3	2,794,552.00	2,294.46	215,180,500.00	199,617.88	368.00
JOS	72	14.43	2	5,517,973.00	1,731.08	204,165,000.00	76,167.61	93.00
CAL	82	14.7	3	3867089	1125.73	479519000	139590.69	279
SOK	112	14.98	3	1553448	633.74	90100000	36757.00	88
ILO	122	16.72	3	0	1728.75	0	110639.76	260
FUTO	163	7.89	.	N/A	13957.6	N/A	1577208.92	141
MIN	173	12.90	2	2303310	515.45	71402600	15979.00	53
YOL	203	10.69	2	1568182	624.44	17250000	40588.90	227
	Grand Total	23.40	3	6375463	3372.51	4870853829	3210624.8	7182

The key for university code is found in the appendix , ₦80.0 =$1.0 in 1997

The mean age of Ibadan buildings was 37.63 years which was the highest, confirming Ibadan as the oldest University. University of Nsukka was noted to have the worst condition of building with an average condition of 5. Hence the average estimated cost of repair for the University of Nsukka was stated at ₦18, 292, 517.00 ($228,656). The average estimated cost of repair for University of Ibadan was ₦8,067, 391.00 ($100,842) and ₦3,750,594 ($46,882) for Ahmadu Bello university, showing the extent of disparity between other Universities and the University of Nsukka.

The sum of number of blocks shows that Nsukka has the highest number of blocks, stated at 3344 blocks. Not surprising therefore, the total estimated cost of repairs for other universities range from ₦17.2 million for third generation University to ₦557 million for the first generation Universities but Nsukka had approximately ₦2.7 billion ($3.4M).

6.3 DEVELOPMENT OF LINEAR MODELS

This section describes the process of developing and testing of the funding model. The aim is to select and develop an appropriate form of model and verify to the performance of the model. The section critically evaluates the development, testing and verification of the model using the data provided by the Universities.

6.3.1 The Purpose of the Model

In the overall context of the study, the purpose of the modelling stage of this project is to produce a model which could be applied in funding capital projects in Nigerian Federal Universities. The funding of Universities by the generation model was considered inadequate. Furthermore, the use of just one variable as in the FTE model has also been regarded as inadequate. Hence the need for a more scientific transparent and equitable means of fund allocation which is the basis of this model.

6.3.2 The Form of the Model

In arriving at the appropriate form of the model, due consideration was given to the models input, output and to the context of its application.

(a) **Model Input**

The data collected from the Universities was earlier presented in this chapter. Though data was collected for the year 1998 and 1999, the development of the model was based on 1997 data since that was the data collection period for the project. The variables for which data were obtained are:

1. Estimated cost of repairs.
2. Floor area.
3. Condition of building
4. Age of building.
5. Number of blocks

It should be noted that factors 1,3, and 4 above i.e. (estimated cost of repairs, condition of building and ageing of building) are closely interwoven. However, the outstanding factor amongst them is that of ageing of buildings since it is the universal concept that, all things being equal, as a building advances in age, the more the conditions deteriorate and the higher the maintenance cost rises. Brief literature reviews are being undertaken hereunder to help explain the philosophy behind the input of the above stated variables.

(b) **Ageing and conditions of buildings**

It was observed during the condition survey that the defects in various University buildings were prominent on elements such as roof, walling, plastering and painting. Due to perhaps, poor standard of workmanship and defective materials, the conditions deteriorated with time. Brief literature reviews are undertaken here of some of the building components, viz, roof, walling plaster and paint. Over 95% of the sampled buildings were: (i) Roofed with reinforced concrete slabs covered with bituminous felt but which are now being phased out to be covered with corrugated long span aluminium sheets carried by timber roof structures, (ii) Walled with precast sandcrete hollow blockwalling laid in stretcher bond and rendered internally and externally with cement/sand mortar, and (iii) Painted with emulsion paint internally and externally.

(c) **Roof -** Many hardwoods are not resistant to tropical conditions even when locally grown. Certain species will need replacement after as little as three years, if left untreated and fully exposed. Such defects can prove positively dangerous, especially when used for such purposes as balconies, handrails and staircases. Unfortunately, many architects and works supervisors are unable to distinguish between one timber and another except in obvious cases and are unaware of the properties of different timbers. Thus, the same type of timber may be used throughout the whole work despite what is laid down in the specification, (Fullerton, 1967). Roof. **Timber -** Decay in timber used for building works can only be prevented if it is subjected to an effective process of preservation. The low for life requires food, a certain amount of moisture and oxygen for its growth, and the absence of any one of these prevents decay. Effective presentation depends upon the preservative employed and its application. Substances used for wood preservation include, (i) Oil preservatives such as creosote and cone tar, (ii) Unleachable metallic salts, and (iii) Water soluble preservatives of which zinc chloride, sodium fluoride and magnesium silicofluoride.

Corrugated iron aluminium sheets must be well lapped and well detailed at the eaves to prevent wind drags and entry to the roof by rats and bats. Comparatively large timbers are necessary to support the heavy weight of roof covering - 125mm by 50mm spars are used at 400mm centres. They must be strongly prulined, (Mckay, 1975[3]).

(d) **Blockwall and Plaster**

Both the external and internal walls are covered with in-situ cement/sand plaster. As the wall element ages, serious cracks are always noticed due to faulty bonding, wrong mixes in cement/sand mortar specifications, unsatisfactory quality of water and poor workmanship.

(e) **Painting**

It was observed during the condition survey that defects due to paint on walls constituted one of the eyesores of the University buildings. It is a known fact that paint on walls deteriorates with age.

The common defects in paint are due to bloom, blistering, bleeding, cissiing, chalking, defective drying, flashing, fading, fading, grinning, saponification, wrinkling; (curtaining or sagging). Cleanliness is essential, not only so that the surfaces to be painted are free from dust, fluff, grit, greasy finger marks etc. Decoration is usually done from the top down. Large unbroken areas may be difficult to paint with paints that dry quickly as joining up with an area where the paint has partially dried will show brush marks, and perhaps a slight change of tone, (Nield, 1968).

Cement mortar is usually mixture of 1 cement: 3 sand. The sand is placed on a platform, the correct amount of cement is added to it, both are thoroughly mixed dry before water is added and the mass gradually worked up into a plastic condition. As cement mortar sets comparatively quickly, it should only be mixed in small amounts and not be used after it had started to set. The amount of water added after the materials have been turned over dry (by using shovels) must be carefully regulated, as an excess of water considerably reduces the strength of the mortar or concrete. The craft of the blocklayer is conceived with embedding blocks in mortar and suitably arranging them so that the mass called blockwork, conforms with certain requirements such as strength and appearance. Strength depends a good deal upon the bond, (Mckay, 1975[1]).

Where surfaces to be plastered are very smooth, as with concrete from metal shuttering, the provision of a mechanical key may be necessary unless one of the bonding fluid methods is used. A key can be formed in the concrete by using key-forming retards, which delay the set of the surface so that the skin of cement can be brushed off to expose the aggregate. A key can be obtained by halting difficult and messy and now considered unnecessary if some thought is given to the problem before hand. A "spatter" coat of rich cement and sand grout will sometimes be effective as a key. It is thrown on and good adhesion results, giving a rough surface and forming a good key. Special concrete bonding plaster is obtainable which can form the finishing coat or be a base for a finishing coat, (Nield, 1968).

(f) **Dependent Variable**

The scope of the project remains the development of an equitable model for funding the maintenance requirement of existing facilities. It would be expected therefore that the estimated cost of repairs, if prepared by the Universities themselves would be overestimated with the hope of obtaining more funds from the government. However, as the estimated cost of repairs is a dependent variable, it means that any overestimated cost of repairs presented will be distributed proportionally across the Universities, thus making it equitable.

(g) **Independent Variables:**

The aim of this model is to construct a good prediction equation that expresses estimated cost of repairs as a linear function of the selected independent predicted variables. These independent variables includes: number of blocks, building condition, age, and floor area. The development of a model with these variables shows a poor fit ($R^2 = 0.32338$).

(h) **Derived Independent Variables**

A poor fit can be the result of inappropriate formation of the model. To improve the fit therefore, new variables were introduced (second order variables) which are two cross product term of the original independent variable and the squares of the original independent variables.

The resulting derived variables are:

I. Age by floor area.
II. Age by number of blocks
III. Condition by number of blocks
IV. Condition by floor area.
V. Square of age
VI. Square of condition
VII. Square of floor area
VIII. Square of number of blocks

6.3.3 Model Development

In all the models discussed the dependent variable is the estimated cost of repairs. The independent variable include floor area, condition of building, age of building and number of blocks. New variables such as the interaction terms were created from these variables.

- **Model 1**

Stepwise regression was then used to determine the best subject of potential predictor variables. The output for model 1 is shown on table 6.11.

(i) Modelling Estimated Maintenance Costs

New variables such as age and the interaction terms were created from the variables. Stepwise regression was then used to determine the 'best' subset of potential predictor variables. The output is shown below.

Response is COST97 on 14 predictors, with N = 404 N cases with missing observations = 457

all cases = 861

TABLE 6.11: OUTPUT FOR MODEL I

STEPS	*1*	*2*	*3*	*4*	*5*	*6*
Constant	*5057177*	*3909205*	*2807847*	*887262*	*905154*	*1810200*
X_1	*2059*	*1800*	*1538*	*1466*	*1421*	*1390*
T-Value	*17.44*	*15.46*	*13.74*	*13.26*	*12.96*	*12.8*
X_2		*165*	*384*	*367*	*218*	*429*
T-Value		*7.37*	*11.53*	*11.21*	*4.18*	*5.31*
X_3			*-0.015*	*-0.0143*	*-0.031*	*-0.03*
T-Value			*-8.39*	*-8.23*	*-6.27*	*-6*
X_4				*22963*	*18972*	*11791*
T-Value				*4.42*	*3.63*	*2.11*
X_5					*39*	*47*
T-Value					*3.62*	*4.37*
X_6						*-1140*
T-Value						*-3.38*
S	*8309109*	*7807405*	*7208622*	*7046910*	*6942524*	*6853069*
R-Sq	*43.07*	*49.87*	*57.37*	*59.36*	*60.66*	*61.76*

This shows that 457 of the 861 buildings had incomplete data required for the analysis. The model contains six variables and explains 61.76% of the variation. Model 1 can hence be stated as follows:

$1810200 + 1390X_1 + 429 X_2 - 0.0295 X_3 + 11791 X_4 + 47 X_5 - 1140 X_6$

Where:

X_1 = Square of number of blocks, X_2 = Condition of building by floor area,

X_3 = Square of floor area, X_4 = Condition of building by age of building,

X_5 = Age of building by floor area, X_6 = Floor area.

The result obtained from model 1 suggest several findings:

1. Number of blocks square is the most important factor predictor variable. The others followed in this order, condition by floor area, floor area squared, condition by age, age by floor area and floor area.
2. Floor area and the square of floor area have negative regression

coefficients. Hence, building with larger floor area requires less in maintenance cost relatively. This deduction supports the theory in construction economics that building with large floor area tends to have lower cost/m2

3. The R^2 of 61.76% obtained, indicates greater potential of the modelling process.

The Nsukka Effect

Close examination of the standardised residuals from model 1 shows some building from a particular university (Nsukka) had much higher costs than predicted by the model. A dummy variable that identify building of the university of Nsukka was included in the model. With this, it was possible to determine whether Nsukka buildings did indeed have significantly different estimated cost from other Universities other factors being equal. In addition, it would be possible to estimate the size of the "Nsukka Effect".

The Nsukka effect was included in the model as the second most important factor after number of blocks squared. Its regression coefficient shows that other things being equal, estimated cost for the University of Nigeria, Nsukka requires ₦7,406,137 ($92,577) more than other Universities. Since the Nsukka effect was this influential, retain Nsukka in the data set would affect the model, hence its records were deleted.

The Nsukka factor on this model has further supported previous research findings that classified Nsukka buildings as the most poorly maintained in the whole system.

The report of the Committee on University Finances, popularly known as *Ogundeko Report* (1978), stated as follows:

"The facilities of University of Nsukka, stand out as poorer than
those of other Universities in terms of design, state of maintenance

and adequacy" (Ogundeko, 1978, P.8, Item 16.)

Similarly, the final report on the 1992 Special Capital Grant of ₦25.0 ($1.3m) million to each University described the dilapidation level of Nsukka building as the worst in all the system, especially their Students' Hostel (NMC Report, 1994). Equally revealing is the estimated cost of providing space deficiencies in the Nsukka, estimated to be the highest in 1992 by the accreditation requirement. (Accreditation Report, 1992).

The elimination of data from Nsukka for this work has therefore been justified, but more importantly, this research has confirmed the previous findings on the University physical facilities and has provided greater information on the condition of its buildings, which have the highest mean of condition 5.

To demonstrate the Nssuka effect mathematically, it was decided to include a dummy variable in the model that identified Nsukka buildings. It was then possible to determine if Nsukka buildings did indeed have significantly different estimated costs from other Universities, *other factors being equal.* In addition, it would be possible to estimate the size of this *'Nsukka effect'*.

The output for this analysis is shown below:

TABLE 6.12: THE NSUKKA EFFECT

Steps	*1*	*2*	*3*	*4*	*5*	*6*	*7*
Constants	*5057177*	*-4330950*	*-4856968*	*-4608182*	*-5188486*	*-6780866*	*-5869017*
X_1	*2059*	*1812*	*1586*	*1389*	*1312*	*1728*	*1747*
t-value	*17.44*	*16.07*	*14.38*	*13.07*	*12.58*	*10.1*	*10.25*
Nssuka		*7530108*	*7099409*	*6130343*	*6273844*	*7952653*	*7406137*
t-value		*8.47*	*8.48*	*7.73*	*8.14*	*8.45*	*7.68*
X_3			*153*	*342*	*146*	*145*	*291*
t-value			*7.39*	*10.87*	*2.97*	*2.97*	*3.68*
X_4				*-0.0128*	*-0.0343*	*-0.037*	*-0.0352*
t-value				*-7.63*	*-7.53*	*-8.05*	*-7.63*
X_5					*49.7*	*54.2*	*58*
t-value					*5.06*	*5.51*	*5.85*
X_6						*-17397*	*-18790*
t-value						*-3.05*	*-3.29*
X_7							*-737*
t-value							*-2.34*
S	*8309109*	*7662666*	*7197184*	*6731608*	*6533150*	*6466112*	*6429901*
R-sq	*43.07*	*51.71*	*57.5*	*62.92*	*65.16*	*65.96*	*66.42*

where X_1=number of blocks squared

X_1=Nssuka effect, X_3=condition of building by floor area,

X_4=floor area squared, X_5=age by floor area,

X_6=condition by number of blocks, X_7=floor area,

The Nssuka effect is included in the model as the second most important factor after number of blocks squared. Its regression coefficient shows that, other things being equal, Nssuka estimated costs are 7,406,137 higher than those for other universities. It was decided that retaining Nssuka in the model would seriously skew the model and hence its records were excluded.

- **Model 2**

The data set with "No Nsukka" cases was then used to reconstitute a second model.

The output for model 2 is shown on table 6.13

Response is N (cases COST97 on 13 predictors, with N = 555 with missing observations) = 277 N(all cases) = 832.

X_1= Age of Building by floor area

X_2=Number of blocks by condition

X_3= Square of floor area

X_4= Square of numbers of block

X_5= Floor area

X_6= Condition of building by floor area.

TABLE 6.13 OUTPUT OF MODEL 2

STEP	*1*	2	3	4	5	6	7
Constant	*1737724*	*1391959*	*979078*	*1060673*	*1101086*	*1191722*	*1204608*
X_1	*24.74*	*18.4*	*38.27*	*44.54*	*47.16*	*51.18*	*47.59*
T-Value	*31.42*	*22.23*	*14.53*	*15.01*	*18.85*	*16.48*	*14.79*
X_2		*33841*	*31863*	*9333*			
T-Value		*13.55*	*13.38*	*1.64*			
X_3			*-0.0156*	*-0.0198*	*-0.0214*	*-0.022*	*-0.0226*
T-Value			*-7.9*	*-9.12*	*-10.97*	*-11.2*	*-11.59*
X_4				*613*	*824*	*867*	*830*
T-Value				*4.34*	*14.15*	*14.14*	*13.53*
X_5						*-139*	*-456*
T-Value						*-2.17*	*-4.29*
X_6							*130*
T-Value							*3.72*
S	*3150168*	*2731233*	*2590878*	*2549887*	*2553789*	*2545261*	*2516063*
R-Sq	*64.1*	*73.06*	*75.8*	*76.6*	*76.49*	*76.69*	*77.26*

In model 2 as compared to model 1, the total numbers of predictor variables has now reduced to five. Condition of building, age of building were thrown out of the model by removing the "Nsukka effect". Even the importance of the predictor variable now changed fundamentally, with condition of building by floor area becoming the most important predictor variable.

The P-values in model 2 were extremely small (0.000 in all cases), indicating that all variables should be retained in the model.

The analysis of variance table also shows a P value of 0.000 indicating there is every reason to believe that the relationship in the model 2 exists. The goodness of fit measure R^2 is now improved to 77.26%.

- **Model 3**

Consideration of the standardized residuals showed the statistics of unusual cases. Building having estimated cost substantially different from that predicted by the model were coded as missing values, though there was no obvious reason why these particulars building should depart from the model. A total of 5 buildings were therefore excluded at this stage. Further checking of the data and clean up were done and the model reconstituted as in the output for model 3 below:

Model 3 can hence be stated as follows:

$$\text{COST OF REPAIRS} = 1130979 + 47.88X_1 - 0.0220X_2 + 849X_3 - 468X_4 + 121X_5$$

Where:

X_1 = Age of Building by floor area

X_2= Square of floor area

X_3 = Square of numbers of block

X_4 = Floor area

X_5 = Condition of building by floor area.

Model 3

Response is C0ST97 on 13 predictors, with N = 550

N(cases with missing observations) = 282 N(all cases) = 832

TABLE 6.14: OUTPUT OF MODEL 3

Step	1	2	3	4	5	6	7
Constant	*1622666*	*1279675*	*886960*	*973518*	*1006647*	*1118651*	*1130979*
X_1	*24.72*	*18.40*	*37.41*	*44.09*	*46.25*	*51.22*	*47.88*
T-value	*33.94*	*24.74*	*15.91*	*16.78*	*20.87*	*18.70*	*16.90*
X_2		*33693*	*31818*	*7706*			
T-value		*15.01*	*14.98*	*1.53*			
X_3		*-0.0149*	*-0.0194*	*-0.0207*	*-0.0214*	*-0.0220*	
T-value			*-8.47*	*-10.09*	*-11.99*	*-12.38*	*-12.82*
X_4				*655*	*830*	*883*	*849*
T-value				*5.24*	*16.11*	*16.35*	*15.72*
X_5						-172	-468
T-value						-3.05	*-5.01*
X_6							*121*
T-value							*3.94*
S	*2912839*	*2453759*	*22309038*	*2255130*	*2257870*	*2240941*	*2211594*
R-Sq	*67.76*	*77.17*	*79.82*	*80.78*	*80.70*	*81.03*	*81.55*

The recorded improvement from 77.26% to 81.55% was tremendous. This was considered sufficient for this project and model 3 was taken as the final model.

(d) How Good is The Model

Residuals are the difference between what is actually observed and what is predicted by the regression equation. That is the amount of variance which has not been explained by the regression equation. Hence ei is the observed error if the model is correct. In performing the regression analysis we made certain assumptions,

> *that the error are independent, have zero mean, a constant variance and follow a normal distribution. Hence if our model is right, the residuals*

should exhibit tendencies that tend to conform with the assumptions.

The ways of examining the residuals are all graphical and are usually very revealing when the assumptions are violated. The principal ways of plotting the residual as applied to the work are as follows.

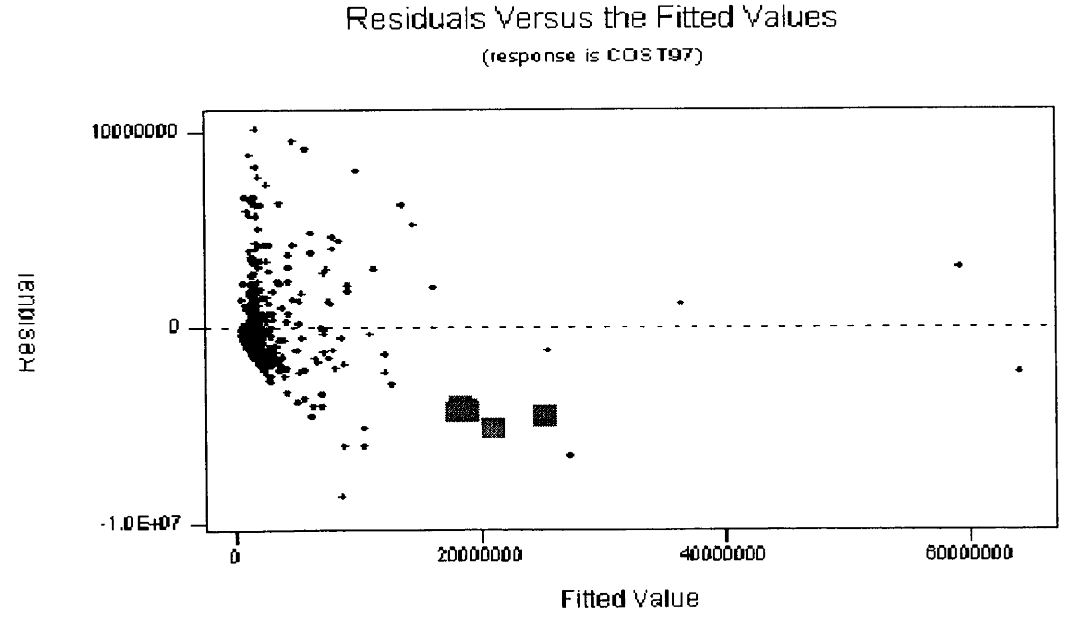
a. Residuals versus fitted value
b. Histogram of residuals
c. Normal probability plot.

(i) **Residual versus fitted values**

The residuals versus the fitted value should be random in nature if our model is correct. An abnormal plot would demonstrate a particular pattern. These pattern may be the result of

1) absolute value of residuals increasing as fitted value increase
2) the departure from fitted value is systematic
3) residuals display circular pattern as fitted values increase.

Chart 6.1



These abnormalities indicate that

1) The variance is not constant over sections of the data scale

2) There is an error in the analysis

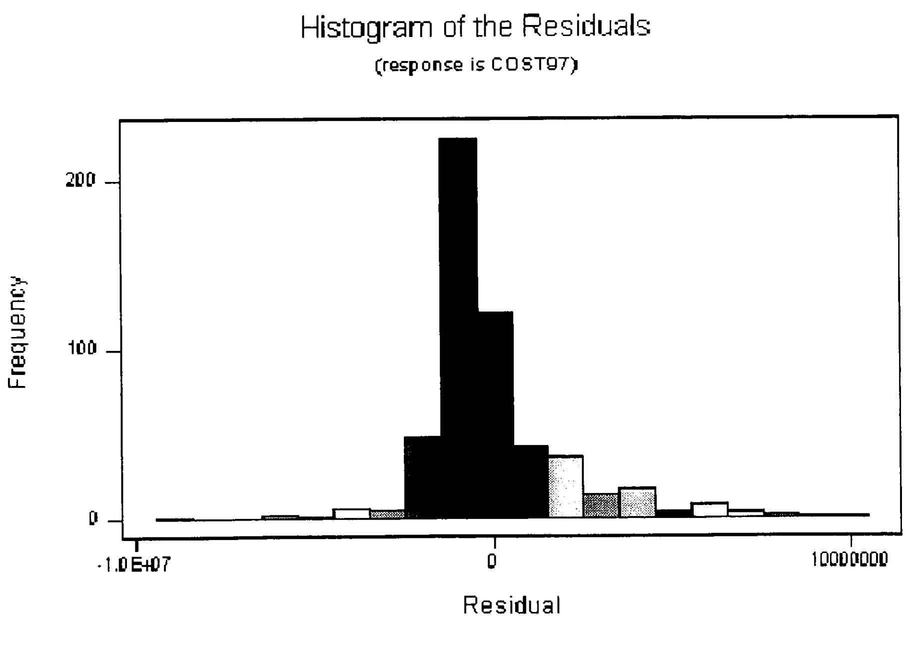
3) The model is inadequate ie requires more explanatory variables respectively.

The plot observed from our regression exhibit slight irregularities but it does not appear to be abnormal.

(ii) Histogram of residuals

We can tell the extend to which the plot above is abnormal by constructing a histogram of the residuals if the number of cases is large as in this study. The histogram obtained from our regression depicts slight irregularities but appears to be normal

Chart 6.2



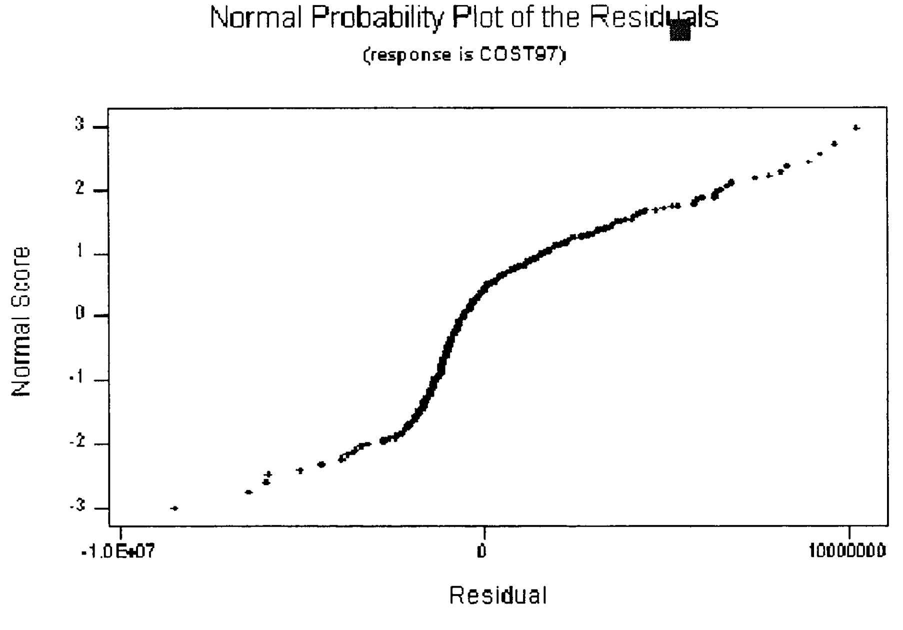
(iii) Normality probability plot

The cumulative normal probability plot of the residual clearly demonstrate this abnormality. If the model is excellent this plot should fall on the trace line or the diagonal line.

Our normal probability curve does fall on the trace line at the start and the end of the residuals scale but our spacing from the trace line becomes wider as we move from residuals zero towards the second half. Hence the plot exhibit a slight irregularity but it is not abnormality.

6.3.4 Application of the Model

Chart 6.3



Using model 3, estimated cost of repair for each building was predicted . These predicted values were then aggregated for each University. The total of the predicted estimated cost of repairs for all Universities was obtained. The total predicted Estimated cost of repairs from the model was more than the available funds allocated by the Federal government for maintenance purposes.

Therefore, the model allocation for each University was computed as the proportion of its predicted estimated cost of repairs to the total available funds. i.e.

$$\text{Model allocation} = \frac{\text{Predicted aggregate for each University}}{\text{predicted aggregate for all University}} \times \text{Available funds}$$

Computation for 1997 and 1998 were carried out and compared.

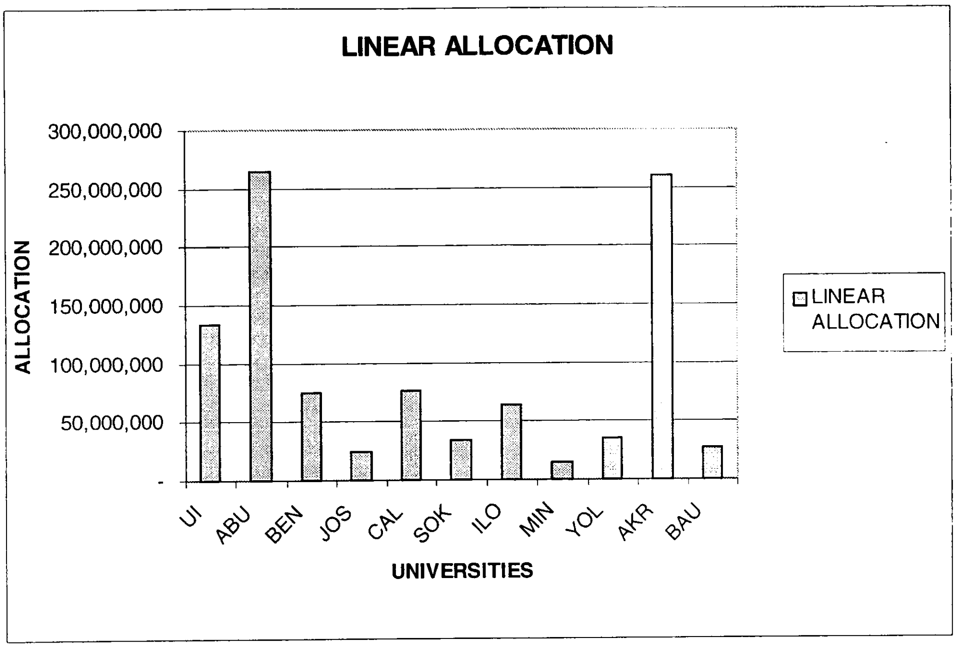
Table 6.15: Comparison between predicted linear allocation and actual allocation by Generation model

Uni name	Uni Code	Pred. Aggr. For Each Uni.	Proportional Allocation by Model.	Actual allocation by generation	FTE Allocation 97
UI	11	348000000	133932753.2	95538080.98	54630366.3
ABU	41	689000000	265171456.8	95538080.98	77203460.9
BEN	61	196000000	75433389.74	95538080.98	56093185.2
JOS	72	62099272	23899788.71	65219489.9	57718317.1
CAL	82	197000000	75818253.98	65219489.9	82430182.8
SOK	112	87287374	33593788.28	65219489.9	38863028.5
ILO	122	166174764	63954723.15	65219489.9	89077362
MIN	173	39300763	15125458.02	67047868	52714571.5
YOL	203	92414885	35567183.87	67047868	58187744.7
AKR	183	675363227	259923150.6	67047868	85888129.2
BAU	143	71403636	27480705.63	67047868	65348008.9
	Total	2624043921	1009900652	815683674.54	718154356.9
		100%	38.5	31.1	27.7

PRED. AGGRE. - Predicted Aggregate, GEN. MODEL - Generation Model

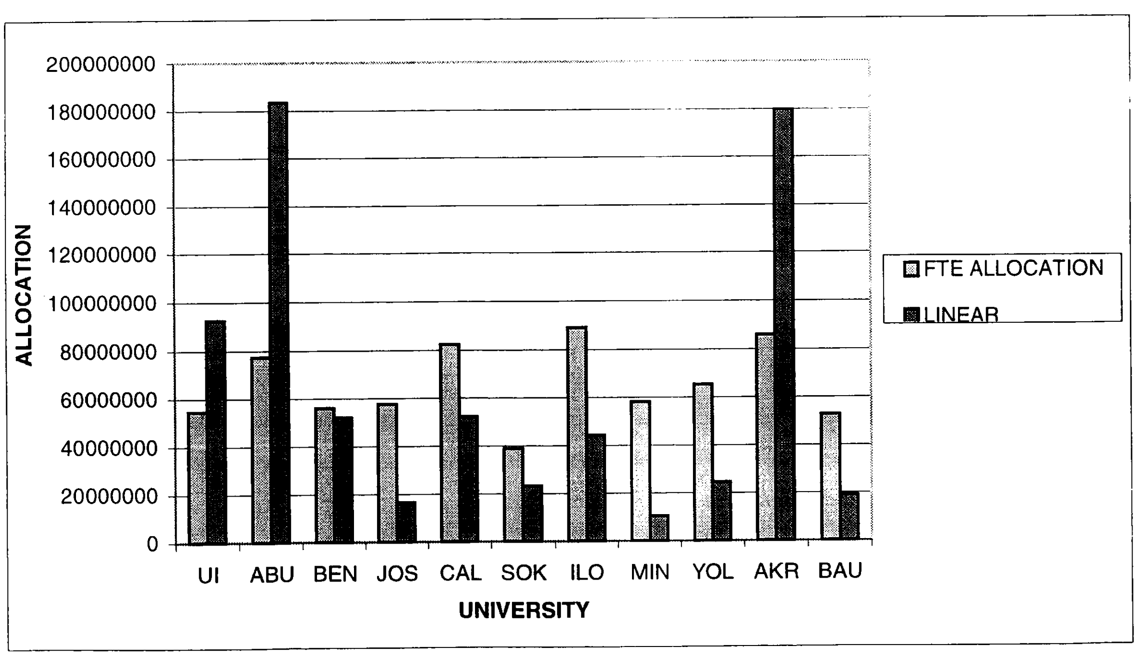
₦80.0 = $1.0 in 1997

Chart 6.4



Previous allocations using other models were compared with the model allocation in order to draw conclusions.

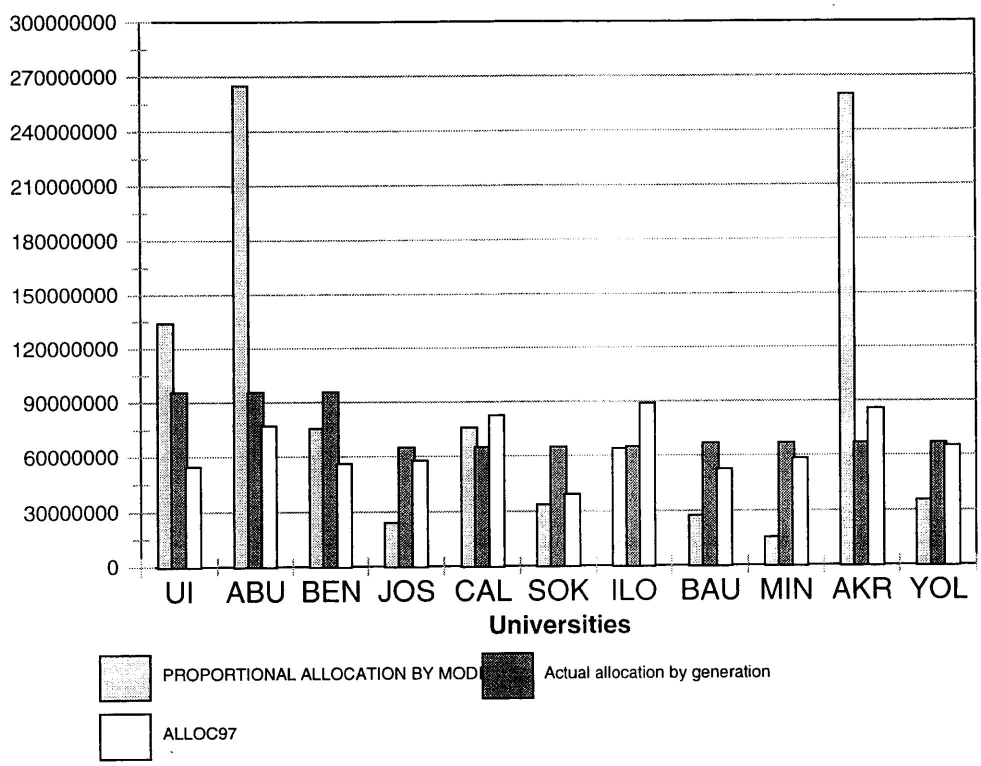
Chart 6.5 COMPARISON BETWEEN FTE ALLOCATION AND LINEAR ALLOCATION



The charts below are grouped charts of allocation for the Universities actual

Generation model and the model 3 for comparison.

Chart 6.6: Comparison between Generation, FTE and Linear allocation Models



6.4 HYPOTHESIS TESTING USING THE MODEL

The statistical hypothesis, as defined earlier are

(1) Ho = B1 = 0

Implying that there is no relationship between estimated cost of repairs (dependent variable) and the suggested independent variables in the equation. In other words, the generation model is equitable.

(2) Hi = B1 0 (not equal to zero)

Implying that there is a relationship between the dependent variables and the independent variables. This means that the generation model is inequitable to most Universities.

The F- statistics for estimating the usefulness of the model, that is testing the null hypothesis that all the models parameters equal zero is

$$F = \frac{\text{mean square (model)}}{\text{mean square (error)}}$$

From the result of model 3, all the parameters that entered the model have T-values greater than zero, thereby supporting the alternative hypothesis that B1 0. (Not equal to zero).This implies that the generation model is inequitable to most Universities.

6.5 SUMMARY OF CHAPTER SIX

This Chapter explains the process of data collection, through the condition survey of buildings in the Federal University system.

The process of conducting the condition survey or assessment of building condition involving three distinct phases was enumerated. These phases include:

Phase I, which involved the setting of scope and content of the survey, selecting the survey Team, preparation of action plan and the extensive briefing/training given to the Team.

Phase II, that involved the actual collection of data, using the questionnaires through postal survey. At first, a pilot study was conducted that collected data from three Universities (ABU,AKURE and Calabar). The data was analysed and the necessary correction made. The full data collection was conducted using a sample of 11 Universities across the country and across the generations of federal University system.

Phase III, that involved the validation of the data carried out by the certification of final submission by each University's official as well as the spot checks conducted by the Researcher to all the sampled Universities. It was discovered that the extensive training programme given to the survey Team and the Universities official contributed tremendously to the success of the data collection exercise as the process was well understood by all the parties involved.

The analysis of data using stepwise method of Linear regression revealed that the condition of building deteriorates with age as the mean conditions of buildings for first generation Universities came to 4, that of second came to 3 while the one for third generation was 2. These therefore support the age differences between the generations of the Universities as relate to their years of establishment. The Linear allocation model was finally developed with cleaned data from 11 Universities. Nsukka buildings were discovered to be worst in terms of maintenance condition and cost of repairs. This finding supports previous studies on the University's buildings. The data from the University was eliminated from the Model to avoid distortion of the final result therefore t. Model 3 was finally accepted as adequate for the research work having attained a goodness of fit value (R^2) of 81.55%. The parameters which entered the model include:

i. Age of building by floor area (X_1)
ii. Square of floor area (X_2)
iii. Square of number of blocks (X_3)
iv. Floor area (X_4)
v. Condition of building by floor area (X_5)

The final equation was given as:

COST OF REPAIRS = 1130979 + 47.88X_1 - 0.0220X_2 + 849X_3 - 468X_4 + 121X_5

The final model was used to estimate the amount of money required for the maintenance of the buildings. The predicted value (by the model) was used to pro-rate and re-allocate the available funds using the 1997 Capital grant allocation by the Government.

The regression coefficients signs are consistent with previous literature except for the negative sign associated with the square of floor area. However it should be noted that larger buildings tended to be older and better built which affects the maintenance costs. The model also includes the interaction of floor area with age (as the single most important variable) and condition making the interpretation of the signs difficult. In addition, the size of the regression coefficients means the size of the square of floor area is much less than the interaction terms. For example, the 'average' building has a floor area of 1859 m^2, is 18.82 years old and has condition 2.95. The contribution to the models of the square of floor area, age times floor area and condition times floor area are –76029, 1675415 and 663660 respectively. A further investigation showed that only one of the 832 buildings had greater contribution from the square of floor area than age times floor area whilst the corresponding figure for condition times floor area was 11.

Verification and validation of the model 3 were carried out using; graphical representation by:

i. Residual versus fitted values
ii. Histogram of residuals
iii. Normal probability plot.

All the three plots indicated the adequacy of the model for practical use.

Allocation using the Linear model was compared with the FTE model allocation and it was observed that the model 3 gave a more equitable allocation.

The values of all the independent variables that entered the model were more than zero therefore supporting the hypothesis that the Generation model is inequitable to most Universities.

Data from the Universities were easily available and will continue to be available annually. As the changes in parameters manifest, the model will be modified continuous to suit the current situation, especially in terms of changes on the building conditions. This situation therefore satisfies the criteria for a good cost model.

From the findings therefore, it can be concluded that the linear allocation model provides more equitable basis for allocating available capital funds to the Universities and could therefore be used.

CHAPTER SEVEN

SIMULATION MODEL AND MAINTENANCE PLANNING

7.1 PREAMBLE

The final model developed in Chapter 6 (Model 3) has expressed the relationship between the dependent variable (estimated cost of repairs) and the independent variables, that is, age of building by floor area (X_1), square of floor area (X_2), square of number of blocks (X_3), floor area (X_4) and condition of building by floor area (X_5). These relationships were established using the multiple linear regression method of cost modelling. However, the rate of deterioration between buildings within a University campus varies (as reflected by the condition of buildings between 1-8). Furthermore, the resources available to maintain the buildings in a sound and habitable conditions are always in short supply, thereby necessitating the need to evolve a system which would provide options that can assist in selecting optimal maintenance strategy for a particular purpose. Ashworth (1988) confirmed that simulation modelling approach is a powerful tool that can assist in achieving this objective and has been used in solving management problems. It can be used to select the best of a series of alternatives to gain a deeper understanding of the behaviour of a complex system or to determine the overall effect of a proposed change in policy.

This Chapter demonstrates the possibility for the development of a simulation model which can be used in arriving at different strategies for executing maintenance works on the existing building stock. The Chapter basically shows that the possibility exists and that the use of simulation modelling as a planning tool is appropriate for the research.

7.2 SIMULATION AS A MODELLING APPROACH

Basically, there are two types of systems. The deterministic system and stochastic system. Certain events occur in a predictive manner or predetermined manner. For example, the growth in population size can be assumed to follow a predetermined law of growth. Such a process is often referred to as deterministic. A stochastic system on the other hand, is a collection of random variables. For example, the number of buildings that will be in condition five next year are random in nature. A stochastic system is therefore a family of random variables that describes the evolution through time of some process.

It is quite difficult to find a purely deterministic system as most systems are often surrounded by a cloud of uncertainty.

One way of handling this uncertainty in maintenance planning and modelling is to develop simple model, which substantially removes, or in reality, define a way to solve these difficulties. Ashworth (1988, P.272) stated that deterministic-type model presupposes that values can be attributed to all variables. It assumes that these are either known or can be predicted exactly. The stochastic model, however, recognises that the values of some variables will be uncertain and can therefore only be estimated. The probabilistic (stochastic) types of models therefore utilize the concepts of probability theory. Typically, deterministic models are developed using point estimates. However, in view of the level of uncertainty, figures from deterministic models are not entirely accurate. Extensive repetition of this process is carried out to see a wide range of possibilities. Then it is often assumed that among these wide ranges of possibilities, the expected occurrence will not be very different from the average. Hence the average is chosen and taken as a maintenance plan and subsequently into a maintenance budget.

This approach is justified on the basis that it is impossible to estimate exactly the real world, all that can be achieved is a rough approximation of the key figures which represent the situation.

An alternative way of coping with more complex and extensive uncertainty is simulation. That is through the technique of simulations. Simulation refers to the introduction of parameters in a model which attempt to accommodate complexity of the real world. Simulation is particularly useful where a better understanding of the interaction between a group of variables is required. Nurgus, B. (1984) defines simulation as:

> "The process of designing a model of a real System and conducting experiment with this model for the purpose either of understanding the behaviour of the system or of evaluating various strategies for the operation of the system".

The essence of simulation is that single point estimates of data are not sufficient to represent the complexity of the situation. Therefore, the data should be supplied to the model in a non-point estimate form. The result of a simulation model is frequently not a single answer or point estimate, but often-although not always a range showing the possible outcomes. This range is frequently supplemented by information concerning the frequency with which these possible outcomes may occur.

In view of the fact that simulation does not attempt to simplify substantially the situation during the development of the model, it generally provides a greater insight and understanding into the maintenance situation being analysed. As a result of this it is usually easier to choose a particular scenario with more confidence and convert it into a maintenance plan and subsequently into a maintenance budget.

Ashworth (1988) explained the difference between a simulation experiment and a Laboratory experiment. Simulation experiment differs from regular Laboratory experiment in that it can be conducted almost totally on Computer. The most popular method used in simulation is the Monte Carlo method. Ferry and Brandon (1991, P.254) stated that Monte Carlo technique is simply a way of sampling from a distribution or distributions, in a random manner to provide a range of solutions, which may be directed to finding the best solution (or simply to establish the range of possible solutions available). The technique is based on the general idea of using sampling to estimate the desired result. The sampling process requires the description of the problem under study by an appropriate probability distribution from which the samples are drawn. The use of simulation in modelling relies heavily on the use of Computers.

7.2.1 Difficulties in Modelling of Maintenance Work

Maintenance planning and modelling is difficult for three basic reasons:

1. It is not easy to understand the true nature of the relationship between maintenance variable. Although it has been established with a high degree of accuracy (in chapter 6) that the estimated cost of repairs can be determined by the number of blocks, age, floor area and most importantly the condition of building, it is very difficult to estimate this cost with certainty as literature on the maintenance process revealed that it is stochastic in nature. This is seen in many cases, where maintenance cost is often re-estimated due to inaccuracies of the estimates and the leads and lags inherent in their maintenance process. Furthermore, the complex non-linear and interactive relationship in the maintenance process makes it seldom deterministic.

2. *It is difficult to establish the appropriate data.*
   The difficulty in obtaining a precise scale for classifying buildings further complicates the system. To know the precise point where a building change from one condition to another is extremely difficult. Therefore, it can be seen that, the assessment of building condition is intangible enough. In a deterministic process therefore, this level of qualification

can only produce parameter of low accuracy and reliability.

3. *There is a high degree of uncertainty in maintenance planning and modelling.*

The difference in the rate of deterioration between pre-colonial (deteriorating, lower) building and post colonial building (deteriorating faster) makes the grading difficult as well as the expectation of changing condition of building of more complex nature.

These are some of the arguments that lead to the attempt of a stochastic model for maintenance of building stock in Nigerian Universities. Staines (1999) listed the advantages of simulation process for the Nigerian Universities as follows:

(a) Each building is considered separately so history of building carried forward year to year.
(b) Figures based on individual building are used rather than the average building.
(c) Other approach to this model problem would be extremely difficult as there are a vast number of possibilities that can happen to a building over a ten year period.
(d) Each university can be simulated using its transition matrix and cost.
(e) Many different strategies can be tested.
(f) The most important disadvantage noted however, is that the results depend on random numbers generated, so it is not possible to replicate the analysis exactly.

7.2.2 Results of Various Maintenance Strategies for University of Jos.

The simulation model conducted for the University of Jos buildings attempts to show what might be expected to happen to each building under two strategies.

The two strategies are:

(1) Renovating all buildings of condition 8 to condition 2.

(2) Renovating all buildings in conditions 5 and 8 to condition 2.

The input required for the simulation process are the cost of repairs of each building, the condition of each building and the transition matrix from one condition to another.

The choice of the university of Jos was based on the following reasons

(a) Jos provided almost complete data

(b) had a wide range of buildings

(a) Assumptions

The assumptions include that:-

(i) All renovation cost are at 1997 price.

(ii) Transition matrix is constant over time.

(iii) No new buildings are introduced.

7.2.3 Model Output

(a) Transition Matrix

The transition matrix shows the probability of building changing from one condition to another. The transition matrix of building condition from 1997 to 1998 is shown below in table 7.1

Table 7.1: Transition Matrix

	1998	*Condition*					
1997	*1*	*2*	*3*	*4*	*5*	*8*	*all*
1	*11*	*7*	*0*	*0*	*0*	*0*	*18*
	61.11	*38.89*					*100*
2	*0*	*6*	*5*	*0*	*0*	*0*	*11*
		54.55	*45.45*				*100*
3	*0*	*0*	*7*	*32*	*5*	*0*	*44*
			15.91	*72.73*	*11.36*		*100*
4	*0*	*0*	*0*	*3*	*22*	*0*	*25*
	-	-	-	*12*	*88*	-	*100*
5	*0*	*0*	*0*	*0*	*14*	*5*	*19*
	-	-	-	-	*73.68*	*26.32*	*100*
8						*2*	*2*
	-	-	-	-	-	*100*	*100*
All	*11*	*13*	*12*	*35*	*41*	*7*	*119*
	9.24	*10.92*	*10.08*	*29.41*	*34.45*	*5.88*	*100*

From the transition matrix table, 11 of the 18 buildings that were in condition 1 in 1997 were also in condition 1 in 1998 while 7 deteriorated to condition 2. It was assumed that any building that is in condition 1 has a 0.6111 (11/18) probability of remaining in that condition and 0.3889 (7/18) probability of deteriorating into condition 2 the following year. Similarly any building in condition 3 in one year is assumed to have a 0.1591 probability of remaining in that condition the following year a 0.7273 probability of deteriorating to condition 4 and 0.1136 probability of deteriorating to condition 5.

This allows us to simulate the history of every building in the future using the following algorithm.

1. Construct a transition matrix
2. Calculate probabilities for transitions from one step to another
3. All building in condition 8 are taken to condition 2 or all condition 8 and 5 buildings are taken to condition 2.
4. Generate random numbers and change the condition of building according to random number generator. (e.g. if a building is in condition 1 and its generated number is greater than 0.6111, it changes to condition 2.)

5. Aggregate the number of buildings in each (new) condition
6. Sum the new floor area for each (new) condition
7. Compute average condition
8. Sum of estimated cost of repairs for buildings 8 and move these buildings to 2 for that year.
9. Repeat the process for next year with the present state of the system.

This algorithm enables us to find in each year for each strategy

(i) the condition of each building

(ii) The average cost

(iii) the average building condition

(iv) the total and % of usable building

(v) The total and % of usable floor space

(vi) The total and % of usable blocks

The details for each strategy are shown in the table below for the next 10 years

(i) **Strategy 1:**

Assuming all buildings of condition 8 are renovated to condition 2.

Table 7.1.1 Result Table 1997

Condition	N	Total blocks	Total floor area
1	18	18	17202
2	11	19	7758.9
3	44	56	31316.2
4	25	122	64756
5	19	45	14675.6
8	2	3	526
ALL	119	263	136234.7

1997: Renovation cost = 5000000: Average condition = 3.22

Table 7.1.2 Result Table 1998

Condition	N	Total blocks	Total floor area
1	15	18	12449
2	12	19	10564.6
3	11	56	4462.3
4	40	122	62513.2
5	37	45	42543.6
8	4	8	3702
ALL	119	263	136234.7

1998: Renovation cost = 3700000: Average condition = 3.77

Table 7.1.3 Result Table 1999

Condition	N	Total blocks	Total floor area
1	7	7	5525.9
2	19	25	18763.6
3	6	8	2746
4	12	36	34005
5	68	178	69554.7
8	7	9	5639.4
ALL	119	263	136234.7

1999: Renovation cost = 4390000: Average condition = 4.26

Table 7.1.4 Result Table 2000

Condition	N	Total blocks	Total floor area
1	5	5	4866
2	18	22	16686.1
3	10	14	8376.9
4	7	9	2946.7
5	61	164	83176.9
8	18	49	20182.2
ALL	119	263	136234.7

2000: Renovation cost = 16504000: Average condition = 4.61

Table 7.1.5 Result Table 2001

Condition	N	Total blocks	Total floor area
1	4	4	4084
2	32	65	33366.2
3	5	7	4284.1
4	10	14	8598.5
5	56	100	42269.8
8	12	73	43632.1
ALL	119	263	136234.7

2001: Renovation cost = 15070000: Average condition = 4.19

Table 7.1.6 Result Table 2002

Condition	N	Total blocks	Total floor area
1	3	3	2450
2	33	101	62020
3	13	39	16801.3
4	5	7	4284.1
5	50	96	44441.7
8	15	17	6237.6
ALL	119	263	136234.7

2002: Renovation cost =9712000: Average condition = 3.89

Table 7.1.7 Result Table 2003

Condition	N	Total blocks	Total floor area
1	3	3	2450
2	33	64	48983
3	18	67	26004.6
4	9	16	7748.1
5	48	101	48636.7
8	8	12	2412.2
ALL	119	263	136234.7

2003: Renovation cost = 3336000: Average condition = 4.19

Table 7.1.8 Result Table 2004

Condition	N	Total blocks	Total floor area
1	3	3	2450
2	24	38	9406.1
3	20	72	50302.6
4	12	30	14515.1
5	50	86	48042.8
8	10	34	11518
ALL	119	263	136234.7

2004: Renovation cost = 6665000: Average condition = 4.11

Table 7.1.9 Result Table 2005

Condition	N	Total blocks	Total floor area
1	1	1	1949
2	26	61	18753.5
3	11	33	32371.7
4	17	50	18858.5
5	54	105	56881.1
8	10	13	7420.9
ALL	119	263	136234.7

2005: Renovation cost = 5730000: Average condition = 4.24

Table 7.1.10 Result Table 2006

Condition	N	Total blocks	Total floor area
1	1	1	1949
2	24	57	22406.6
3	13	18	4201.3
4	9	62	38555.3
5	58	104	57899.7
8	14	21	11222.9
ALL	119	263	136234.7

2006: Renovation cost = 13096000: Average condition = 4.42

Table 7.1.11 Result Table 2007

Condition	N	Total blocks	Total floor area
1			
2	26	37	21068.3
3	13	42	14510.2
4	14	16	3476.7
5	50	148	82815.4
8	16	20	14364.1
ALL	119	263	136234.7

2007: Renovation cost = 10380000: Average condition = 4.41

(ii **Strategy 2:**

Assuming all buildings in condition 5 and 8 are renovated to condition 2

Table 7.2.1 Result Table 1997

Condition	N	Total blocks	Total floor area
1	18	18	17202
2	11	19	7758.9
3	44	56	31316.2
4	25	122	64756
5	19	45	14675.6.4
8	2	3	526
ALL	119	263	136234.7

1997: Renovation cost = 16875000: Average condition = 3.22

Table 7.2.2 Result Table 1998

Condition	N	Total blocks	Total floor area
1	10	10	8220
2	37	70	29078.3
3	8	10	8308.8
4	35	47	23655
5	29	126	66972.5
ALL	119	263	136234.7

1998: Renovation cost = 34255000: Average condition = 3.30

Table 7.2.3 Result Table 1999

Condition	N	Total blocks	Total floor area
1	4	4	2612.3
2	55	165	85970.3
3	18	38	18632.2
4	14	16	8208.9
5	28	40	20811
ALL	119	263	136234.7

1999: Renovation cost = 13929000: Average condition = 3.06

Table 7.2.4 Result Table 2000

Condition	N	Total blocks	Total floor area
1	2	2	564.9
2	63	148	62923.6
3	26	66	48137.2
4	16	31	16760.8
5	12	16	7848.1
ALL	119	263	136234.7

2000: Renovation cost = 12120000: Average condition = 2.77

Table 7.2.5 Result Table 2001

Condition	N	Total blocks	Total floor area
1			
2	47	112	40850.9
3	33	60	32354.7
4	19	40	41103.2
5	20	51	21925.8
ALL	119	263	136234.7

2001: Renovation cost = 19205000: Average condition = 3.10

Table 7.2.6 Result Table 2002

Condition	N	Total blocks	Total floor area
1			
2	53	114	47276.6
3	19	54	18309.8
4	27	74	55488
5	20	21	15160.3
ALL	119	263	136234.7

2002: Renovation cost = 7759000: Average condition = 3.12

Table 7.2.7 Result Table 2003

Condition	N	Total blocks	Total floor area
1			
2	56	105	47870.4
3	17	30	14566.5
4	21	79	24091.4
5	25	49	49706.4
ALL	119	263	136234.7

2003: Renovation cost = 20333000: Average condition = 3.13

Table 7.2.8 Result Table 2004

Condition	N	Total blocks	Total floor area
1			
2	52	82	70013.5
3	36	84	31756.4
4	10	16	8009.5
5	21	81	26455.4
ALL	119	263	136234.7

2004: Renovation cost = 20081000: Average condition = 3.00

Table 7.2.9 Result Table 2005

Condition	N	Total blocks	Total floor area
1			
2	55	139	81955.2
3	25	34	16819.8
4	23	42	19684.7
5	16	48	17775
ALL	119	263	136234.7

2005: Renovation cost = 11790000: Average condition = 3.00

Table 7.2.10 Result Table 2006

Condition	N	Total blocks	Total floor area
1			
2	44	154	87200.8
3	31	38	15500.8
4	22	31	13806.7
5	22	40	19726.4
ALL	119	263	136234.7

2006: Renovation cost = 18960000: average condition = 3.18

Table 7.2.11 Result Table 2007

Condition	N	Total blocks	Total floor area
1			
2	43	108	49708.6
3	30	95	60105.9
4	21	25	11196.5
5	25	35	15223.7
ALL	119	263	136234.7

2007: Renovation cost = 13056000: Average condition = 3.24

The Summary of the two strategies is presented in table 6.3 below.

TABLE 7.3: SUMMARY OF THE TWO STRATEGIES

	% useable								Mean	
Year	Cost (million)		Faculty		Block		Floor area		Condition	
	8 only	5 & 8	8 only	5 & 8	8 only	5 & 8	8 only	5 & 8	8 only	5 & 8
1997	5.0	16.9	82.4	82.4	81.7	81.7	88.8	88.8	3.22	3.22
1998	3.7	34.3	65.5	75.6	45.2	52.1	66.1	50.8	3.77	3.29
1999	4.4	13.9	37	76.5	28.9	84.8	44.8	84.7	4.26	3.09
2000	16.5	12.1	33.6	89.9	19.0	93.9	24.1	94.2	4.61	2.79
2001	15.1	19.2	75.6	83.2	34.2	80.6	36.9	83.9	4.19	3.08
2002	9.7	7.8	45.4	83.2	57.0	92.0	62.8	88.9	4.19	3.1
2003	3.3	20.3	52.9	79	57.0	81.4	62.5	63.5	4.19	3.11
2004	6.7	20.1	49.6	82.4	54.4	69.2	56.3	80.6	4.19	2.98
2005	5.7	11.8	46.2	86.6	55.1	81.7	52.8	87.0	4.24	2.98
2006	13.1	19.0	39.5	81.5	52.5	84.8	49.3	85.5	4.42	3.17
2007	10.4	13.1	79.8	79	36.1	86.7	28.7	88.8	4.41	3.22
Mean	8.51	17.14	55.23	81.75	47.37	80.81	52.10	81.52	4.15	3.09

TABLE 7.4: COMPARISON OF THE TWO STRATEGIES

COST STRATEGY			FACULTY		BLOCKS		FLOOR AREA		CONDITION	
8 ONLY		5 AND 8	8 ONLY	5 AND 8	8 ONLY	5 AND 8	8 ONLY	5 AND 8	8 ONLY	5 AND 8
Mean	8.454545455	17.13636	55.22727	81.7545455	47.37273	80.80909	52.1	81.51818	4.128182	3.090909
Standard Error	1.438709247	2.108307	5.330207	1.2633551	5.179226	3.469515	5.565641	3.875537	0.112935	0.0422
Median	6.7	16.9	49.6	82.4	52.5	81.7	52.8	85.5	4.19	3.1
Total	93	188.5	607.5	899.3	521.1	888.9	573.1	896.7	45.41	34
Count	11	11	11	11	11	11	11	11	11	11
COST PER			0.153086	0.20905148	0.178469	0.211497	0.162275	0.209658	2.048007	5.529

The summaries provided on Tables 7.3 and 7.4 demonstrate that except for cost, facilities in the University would be more stable if the decision is to use strategy 2 since the standard deviation for each of the facility is always smaller than for strategy 1. Similarly, more facilities would be available if strategy 2 is used as opposed to strategy 1 as the mean value from the two strategies demonstrates. The mean from strategy 2 is always larger, consequently, the cost for using strategy 2 is always higher. This implies that the cost/square metre to maintain the facilities is higher in strategy 2 than that of strategy 1. From the table 7.4; cost/m2 for maintaining the facilities are:

(1) 8 only - N162,275.00

(2) 5 and 8 - N209,658.00

Strategy 1 (8 only) is therefore:

$$\frac{(209{,}658 - N162{,}275}{N209{,}658} \times 100$$

$$= \frac{47{,}383}{209{,}658} \times 100$$

$$= 22.6\% \text{ cheaper than 2 (5 and 8)}$$

The mean condition for strategy 1 is 4.13 while that of (8) are 3.09. Similarly, the cost is ₦2.05million per condition in strategy 1 as against ₦5.53million for strategy 2 per condition of the facility. This type of information will therefore allow the management of the University and the NUC to take decision based on the options provided. If the NUC or the University decided that the benefits of more facilities is more than the marginal cost then option two is the better option. Otherwise, more options can be tried to see the one that maximises the objective of the University. This process therefore would assist in selection of the most optimum strategy.

CHART 7.1

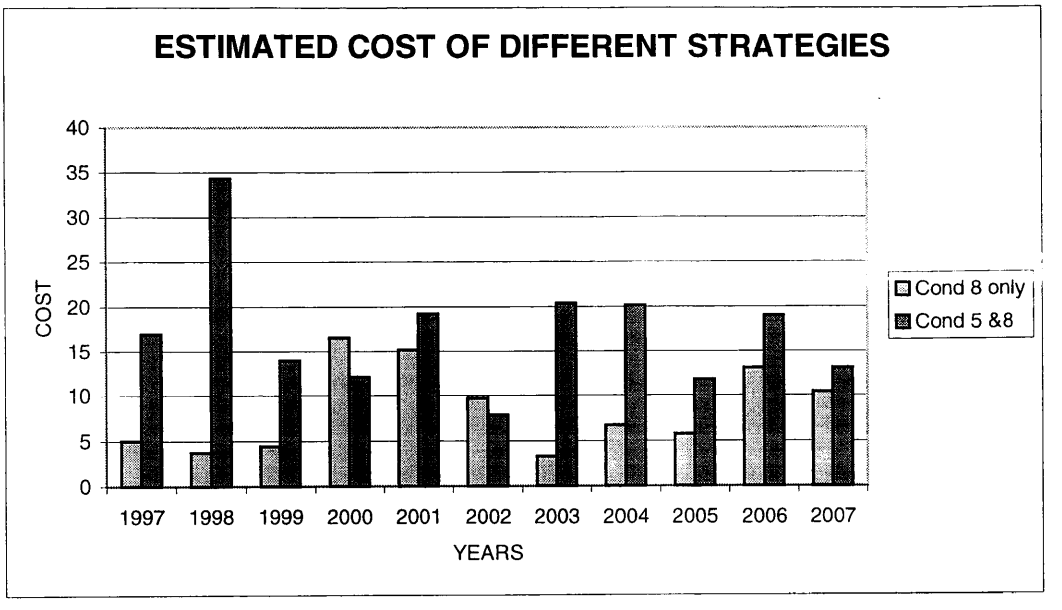


CHART 7.2

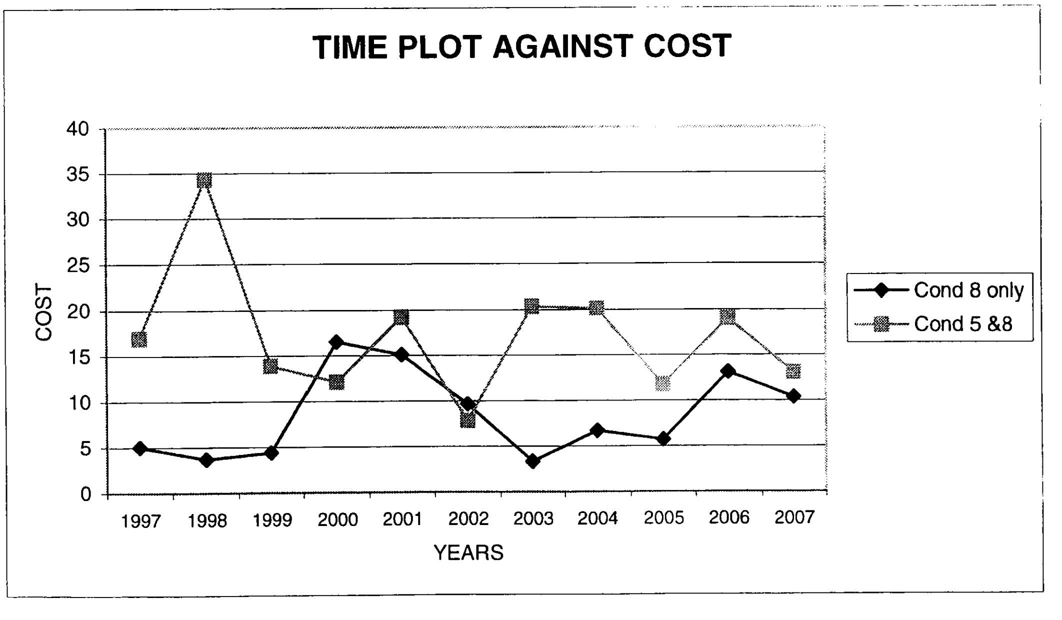


CHART 7.3

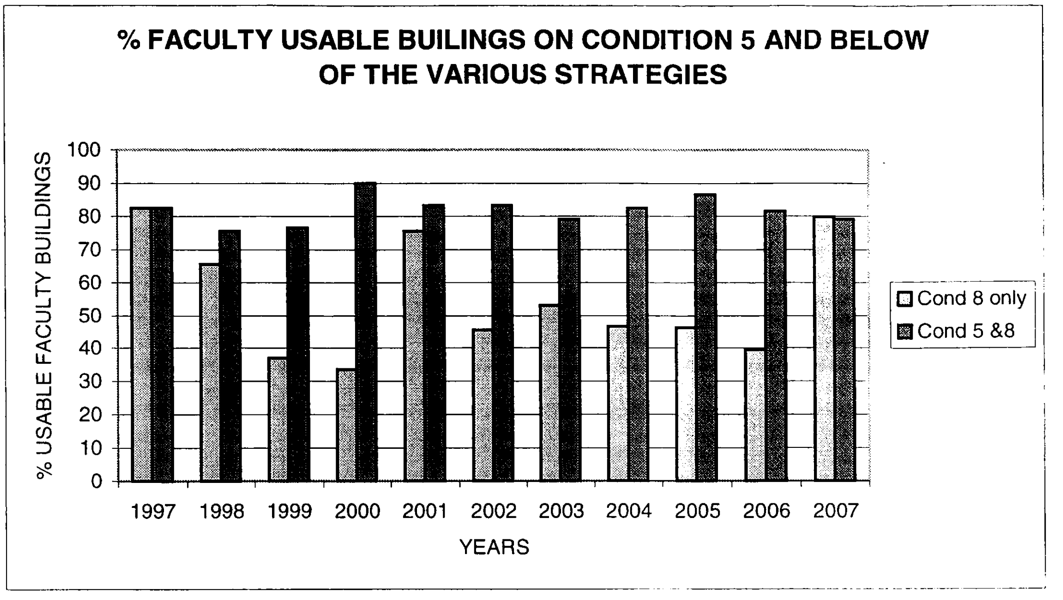


CHART 7.4

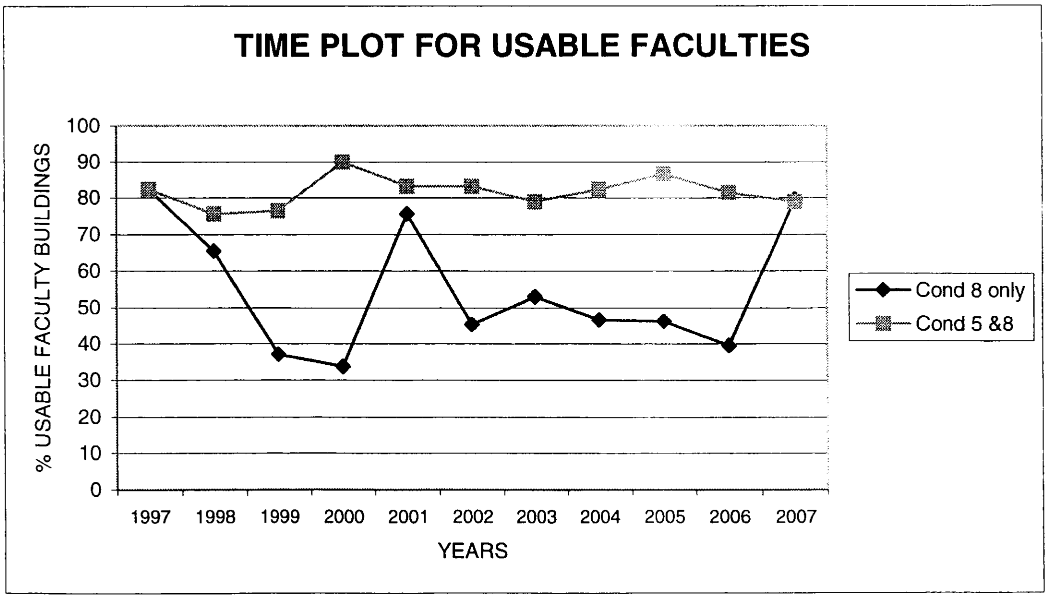


CHART 7.5

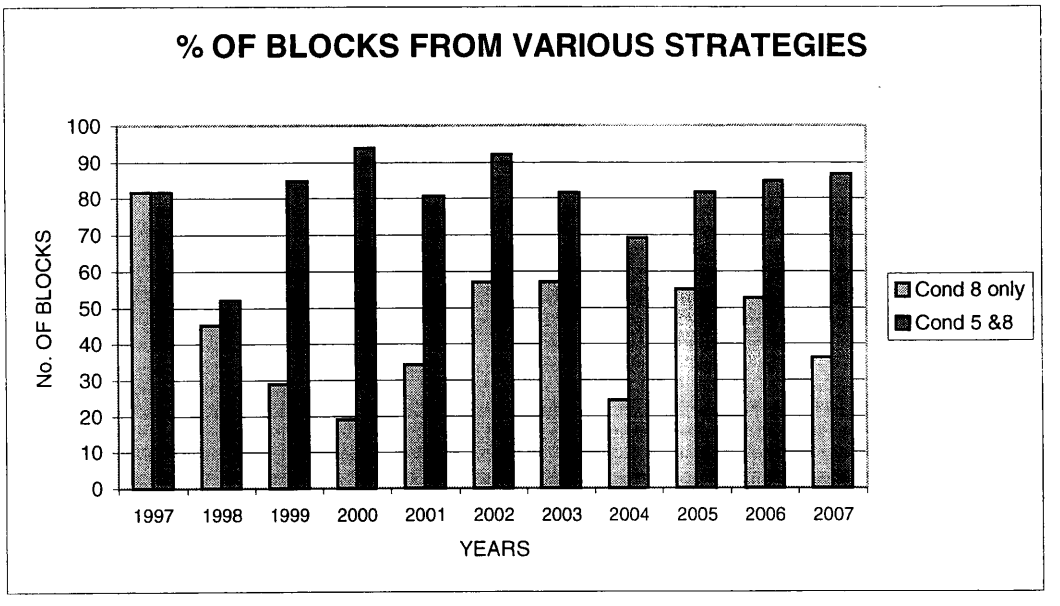


CHART 7.6

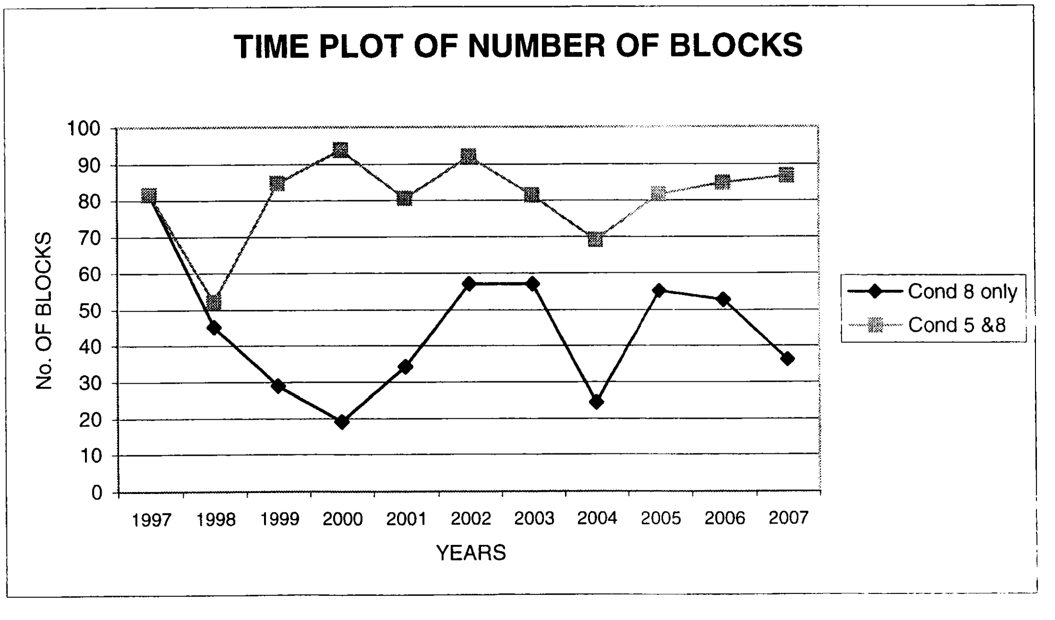


CHART 7.7

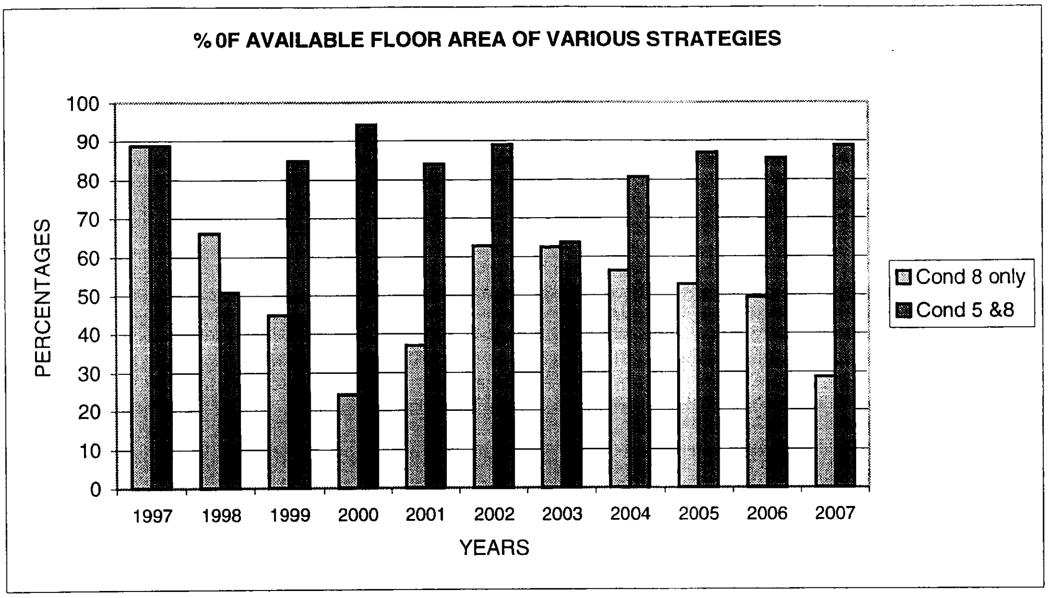


CHART 7.8

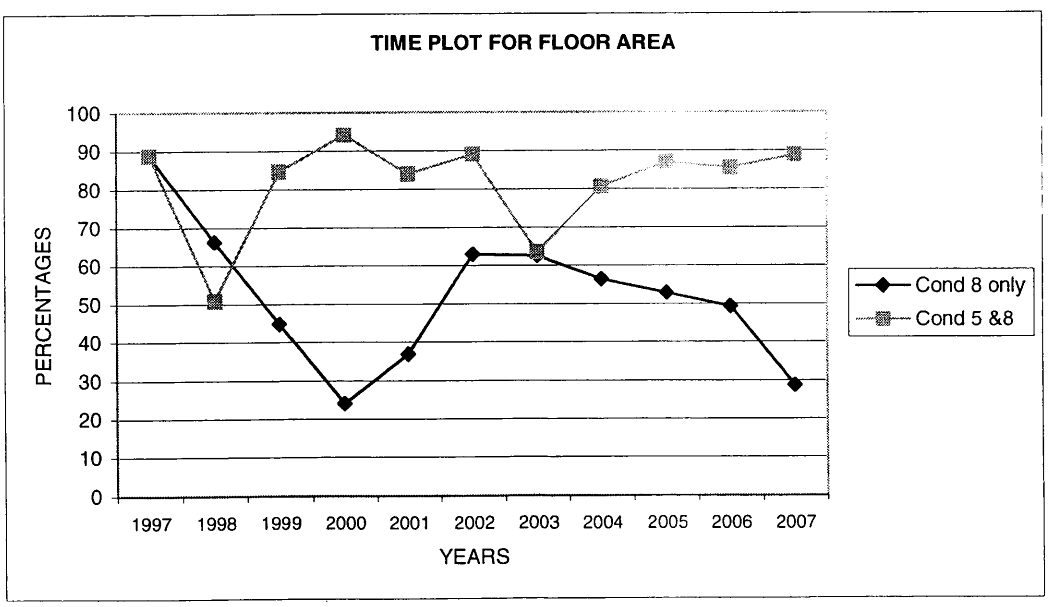


CHART 7.9

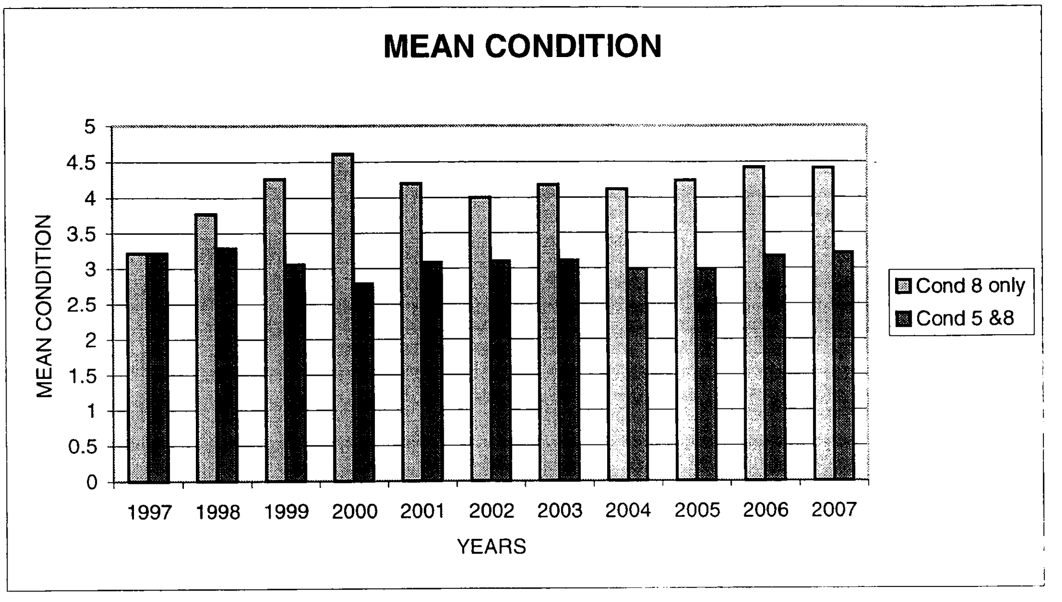
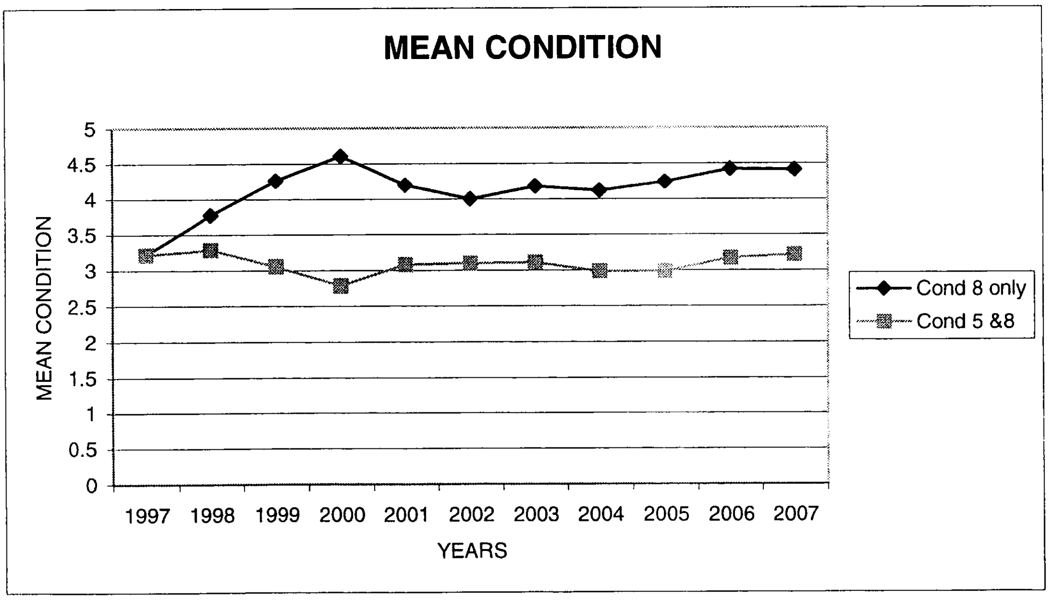


CHART 7.10



7.3 SUMMARY OF CHAPER SEVEN

7.3.1 PREAMBLE OF THE SUMMARY

In the context of the present economic realities, the need for effective planning cannot be over-emphasized. The development of a rational maintenance-planning model for the physical facilities in Nigerian University system has therefore become essential. This is to guarantee the sustainable future of the system.

This Chapter has demonstrated the potential of using simulation-modelling approach to establish various strategies of planning for maintenance work in the Nigerian University system. Using the data from University of Jos, the simulation approach has produced transition matrix for a period of ten years under two different strategies. The first strategy assumed that all buildings in condition 8 will be renovated to condition 2. While the second assumed that all buildings in conditions 5 and 8 will be renovated to condition 2. Tables 7.3 and 7.4 provided the summary and comparison of the two strategies. The cost advantages, it was discovered that strategy 1 has a lower cost/m2 of renovation cost and therefore cheaper for the system. However, strategy 2 would appear to provide higher quality buildings but at a higher cost also.

The approach therefore produced strategic options for the Managers of the University system to take an informed decision.

7.3.2 Data Generation and Management

The process of the data collection from the Universities on the condition of their buildings, will now be intensified and made regular (i.e. annually). Quality control measures would also be undertaken to enhance the authenticity of the data collected.

In terms of data management, the development of a database to maintain these data elements, has now started. The fully developed data base would store information on the:-

a. Date of construction for each building
b. Date of last renovation
c. Condition of the building
d. Floor area
e. Number of blocks
f. Type of building, and
g. Estimated cost to repair the building

The development of this database forms a significant contribution to knowledge as such information on the Nigerian University system does not exist before now. The database will therefore, be a reference materials for future research work.

7.3.3 The development of software to produce the following report is envisaged:

a. Frequency of the different conditions of building for all the Universities.

This report will produce frequency of building conditions for all the Universities. The result obtained will assess earlier maintenance strategies and state whether buildings are improving or deteriorating.

A similar report for each university can be produced to compare the pattern within and across the Universities in order to grade them in terms of maintenance performance.

A time plot of buildings for a 3-year period in line with the present 3-year Rolling plan policy would then be produced for each maintenance strategy.

b. **Transition table for some years.**

This report will produce frequency of building changing from one condition to the other.

The result obtained will assess early maintenance strategies and aid in taking decision regarding changing strategies or not.

A similar report for each unit can be done also to compare with the general pattern.

c. **Cost Estimate**

This report will produce cost estimates for different strategies .

A time plot of estimated cost for each strategy would be produced.

d. **Building to be repaired.**

The building to be repaired will be listed. This is in respect of any strategy which was decided upon.

e. **University allocation**

When the buildings to be repaired are decided by the strategy, the sum of all estimated cost of repairs sorted by Universities will produce their report.

A time plot of unit allocation for future years will then be produced.

This Chapter has therefore demonstrated the important role which a simulation approach will play in effective planning and prioritisation of capital projects in the Nigerian University system.

CHAPTER EIGHT

8.0 FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

8.1 PREAMBLE

The conclusions were developed by way of critical review of the extent to which the aims had been achieved. From the review, the extent to which the overall hypothesis was supported or rejected by the investigation was also determined. Sections 8.2 and 8.3 present the result of these reviews. Recommendations for future work to take care of identified limitations of the current study are presented in Section 8.6.

The aims for the study were:

a. To critically review and analyse the existing patterns of allocating capital grants to the Federal Universities in Nigeria; and
b. To identify appropriate parameters of capital funding and hence to develop a more equitable funding model for future application.

The overall hypothesis was:

The present method of capital funds allocation to the Federal Universities, using the 'generation' or year of establishing the Universities is inequitable. The hypothesis was accepted as valid provided that a means of collecting complete information from the universities was developed and the data used to verify the performance of the predictive cost model.

8.2 FINDINGS

8.2.1 Review of current capital funds allocation pattern

The work undertaken to achieve the first project aim was presented in Chapters two, three and four and the conclusions drawn from the investigation are presented in this section 8.2.

8.2.1a The budgeting process of the NUC. The literature review demonstrated that the planning, negotiating and budgeting system for physical development were robust, well developed, clear and distinct. The literature review also demonstrated that the block grant method of capital budget allocation by the Government appeared to have worked well for the NUC and the entire University system in Nigeria from the 1962 to the mid-nineteen eighties when the economy collapsed. As a result, Government budgetary allocation for the Education Sector in Nigeria was progressively reducing over the period of study. 11.53% of the total budget was allocated to Education in 1997, but only 9.4% in 1998 and 9.7% in 1999. This was much lower than the UNESCO recommended figure of 26% of the country's total budget. The literature review therefore demonstrated that Education budget in Nigeria was much lower than other developing countries like Ghana. Detailed comparison of the procurement method in the United Kingdom and Nigeria revealed that the Nigerian University system had acquired standards which was comparable to the best University in any part of the World. However, the process of implementation derailed the standards. The review further revealed that the Nigerian University system witnessed tremendous changes in terms of rapid growth in students' enrolment and fast decaying infrastructural facilities on campuses.

8.2.1b The growth in students' enrolment and the decay in facilities varied widely even within the Universities of the same age. The rapid growth in enrolment created high demand for physical facilities. With low level of funding experienced by the Universities as a result of low oil revenue, the future of the system became more uncertain, requiring effective preparation of capital expenditure plans.

8.2.1c The review identified the significant factors or components, which affected capital projects and fund allocation to include among other factors:- Full Time Equivalent (FTE) Students enrolment, usable space per FTE as well as the growth rate. Furthermore, the review demonstrated that a cost-modelling approach was used to identify some factors that helped to predict the statistical relationships existing between the two variables.

8.2.1d The modelling concept revealed that the cost of repairs and maintenance work could be estimated with reasonable degree of accuracy. The estimated cost of repairs for the entire University system was used to determine the total requirement for the system. Available funds were therefore allocated on pro-rata basis, in accordance with the needs of each university.

8.2.1e The conclusions that were drawn up from the analysis of secondary data were as follows:

I. The current method of capital funds allocation to the Nigerian Federal Universities did not reflect adequately the needs of the Universities in respect of the students' numbers and areas of specialization. Additionally, no consideration was given to needs in terms of the adequacy of the building stocks and no data was available on the conditions of buildings in the various Universities, although it was known that lack of maintenance had resulted in buildings becoming unusable.

II. Appropriate methods of monitoring capital expenditure were in place but greater emphasis needed to be in place for ensuring adherence to these procedures.

III. The FTE weighted space model was capable of being reviewed every year as the new FTE enrolment data become available. This therefore conformed with the requirement of good cost model.

IV. Finally, the FTE weighted model provided more money to those Universities with more FTE students' enrolment. This further gave support to the claim that virtually, all formulae driven allocation models assume a linear relationship between enrolment and costs.

It can therefore be concluded that the first aim has been fully achieved and supported by the initial part of the study.

8.2.2 identification of appropriate parameters of capital funding and the development of an equitable model

8.2.2.a Parameters. (The work undertaken to achieve this aim was presented in Chapters Six and Seven and the conclusions drawn up from the investigations are provided in this section).

8.2.2b The literature review demonstrated that the Condition survey of existing building stocks provided the basis of identifying and selecting the independent variables, which served as the parameters for capital allocation. The physical assessment of the building stocks using the questionnaires in the sampled Universities brought out the parameters, which were used to develop the cost estimation predictive models. There was clear evidence that the significance of the parameters varied as the models were progressively developed.

8.2.2c Model 3 was finally accepted as adequate for the research work having attained a goodness of fit value (R^2) of 81.55%. The parameters, which entered the model, include:

(i) Age of build by floor area (X_1)

(ii) Square of floor area (X_2)

(iii) Square of number of blocks (X_3)

(iv) Floor area (X_4)

(v) Condition of building by floor area (X_5)

8.2.2d The final equation was given as

Cost of repairs = $1130979 + 47.88x_1 - 0.0220x_2 + 849x_3 - 468x_4 + 121x_5$

(See Annex A Page 276 for a numerical illustration.)

The final model was used to estimate the amount of money required for the maintenance of the buildings. The predicted value (by the model) was used to pro-rate and re-allocate the available funds using the 1997 Capital grant allocation by the Government.

8.2.2e The verification and validation of the model 3 were carried out using; graphical representation by:

1. Residual versus fitted values
2. Histogram of residuals
3. Normal probability plot.

Although some measures of irregularities were observed, the three plots indicated the adequacy of the model for practical use.

8.2.2.f Allocation using the linear model was compared with the FTE model allocation and it was observed that the model 3 gave a more equitable allocation. The values of all the independent variables that entered the model were more than zero.

8.2.2g The data from the survey had demonstrated the potential of using simulation modelling approach to establish various strategies of planning for maintenance work in the Nigerian University system. The approach provided strategic options for the Universities' Managers to take informed decision.

8.2.2h Overall, it can be concluded from the study that the linear allocation model provided more equitable basis for allocating available capital funds to the Universities. Even though, some slight irregularities were observed in the plots of residuals which do not make them abnormal. The predicted aggregate allocation to the sampled Universities in 1997 (Table 6.15) came to ₦2,624,043,921.00 ($32,800,549 @ ₦80.00 = $1.00) while the actual allocation for them by the Government was ₦815,683,674.54 ($10,196,046 @ ₦80.00 = $1.00). This led to the proportional allocation of ₦1,009,900,652.00 ($12,623,754 @ ₦80.00 = $1.00) approximately, 38.5% of predicted value. But the actual allocation was 31.1% of the predicted value.

It can therefore be concluded that the second aim was also achieved.

8.3 CONCLUSIONS ON THE VALIDITY OF THE HYPOTHESIS

8.3.1 Preamble

The cost research process-approach adopted for the study has enabled an appropriate hypothesis to be developed, and tested through systematic data collection by the Condition surveys and the analysis of the collected data.

Qualitative and quantitative procedures were brought to bear on the research. However, the overall conclusion on the validity of the research hypothesis can only be reached by a qualitative analysis of the findings, which emerged from the realisation of each of the research aims.

8.3.2 It appears that the overall hypothesis that "the present method of capital funds allocation to the Federal Universities using the 'generation' or year of establishing the Universities is inequitable" can be sustained based on the following findings:

a. There was strong qualitative evidence from the literature review, which demonstrated that the Nigerian University system witnessed tremendous changes in terms of rapid growth in students' enrolment and fast decaying infrastructural facilities on campuses. There was also the strong qualitative evidence that the growth in student enrolment and the decay in facilities varied widely even between Universities of the same age.

b. These findings were supported by strong qualitative evidence from the literature review, data collection and the cost modelling work which demonstrated, and explained, the high degree of variability that exists between the building conditions and other parameters identified by the models.

c. The qualitative evidence from the interviews and visits to some of the Universities in the United Kingdom and the comparative analysis of other Universities in Africa through the interview with the former Executive Director of the Association of African Universities (AAU), Professor Ekong (1999) that the procurement process in the Nigerian University system was comparable with that of any University in the developed countries.

8.3.3 The following findings therefore emerged from the successful development of the predictive cost allocation linear model, which tend to support the hypothesis. These evidences comprised:

I. Qualitative evidence that led to the selection of an appropriate form of cost model;

II. Qualitative evidence that it was possible to develop a cost allocation model which was appropriate for the available data, and to verify its performance; and

III. Qualitative and quantitative evidence that the final model could contribute to a greater extent in allocating capital grants to the Federal Universities on a more equitable basis, within a reasonable degree of accuracy.

8.3.4 The limitations of the model development and validation must however be acknowledged. Limited complete data were available from the third generation Universities to support the even development of the model. Model verification was also limited because it was restricted to the Universities that supplied complete data for the analysis. The model also could successfully explain only 81.55% of the estimated cost of repairs.

8.3.5 Notwithstanding, the reservations on the findings relating to the data collection and the predictive cost modelling aspects of this work, there is sufficient evidence to draw a final conclusion on the overall hypothesis.

8.3.6 It can therefore be concluded that the hypothesis which states that, *the present method of capital funds allocation to the Federal Universities,* *using the generation or year of establishing the Universities is inequitable* is to be accepted as valid provided that a means of collecting complete information from the Universities was developed, and that the data were used to further verify the performance of the predictive cost model.

8.3.7 Secondary Conclusions. While the thrust of the research work was concerned with the development of an equitable and acceptable cost allocation model, there were a number of areas in the study where strong evidence to support existing theories were found;

a. Evidence in the literature review demonstrated support for the two theoretical perspectives relating to policy and organisational change in Nigerian higher education system. These were Resource dependency perspective and Neo-institutional perspectives stated by Gornitzka (1999).
b. Qualitative evidence to support the claim that the capital funds allocated to the Universities by the Government in 1997 was much lower than the actual requirement of the Universities (Table 6.15).

8.4 RECOMMENDATIONS

8.4.1 Preamble. This study was described in Chapter One as being principally of 'problem solving'. Essentially, the purpose of any research work is to investigate and provide factual evidence that would allow general conclusions to be drawn on the subject investigated and to identify useful future direction for further work in the area. From the conclusions drawn in this study, the following recommendations are put forward:

8.4.2 Implementation Strategies

The new method of allocation should be both formula and non-formula driven to allow for a good balance. The implementation strategies are therefore recommended to cover the following sub-heads:

8.4.2a National Priority Projects

All building in categories 5-8 should be the top most national priority projects for the University system each year.

Special allocation to bring them to satisfactory condition should be considered and the expenditure has to be controlled centrally by the NUC. A reasonable percentage of the total capital grant should be set aside for them.

8.4.2b.National Strategic Pilot Project

With the new innovation coming out every day as a result of technological changes, NUC has to take policy decision of earmarking some special capital funds each year for national strategic pilot projects to be cited in a suitably qualified University. A typical example of such project is the present global, Internet Infrastructure, which is to be started as pilot projects in Universities with the best communication facilities. A reasonable percentage of the annual capital grant should be set-aside for this.

8.4.2c Standard Allocation

Provision should also be made for standard annual allocation to all the Universities to keep their existing buildings in good conditions. As already assessed each building should be kept within grades 1 to 2. The allocation is therefore to bring the conditions of building from 4 to either 3 or 2 each year. A reasonable percentage of the total grant should be set aside for this. Allocation for this category should therefore be formula driven.

8.4.2d New Buildings

Provision also has to be made for construction of new buildings to the Universities with critical shortage of spaces, from the approved rate growth per annum. The submission of request for new project will have to be justified and competed for with others. Options appraisals will have to be submitted by each University. A reasonable percentage of the total capital grant is to be set aside for this.

8.4.2e Reward or Incentive for Efficiency

Each year, a reasonable percentage of the total sum to be allocated should be set aside for the most efficient Universities.

8.4.2f Materials

To avoid early deterioration of structures, it is recommended that the uses of the following should feature prominently: (a) fair faced brickwork and blockwork, (b) well bonded brickwork and blockwork, (c) the minimisation of paint as a decorative material, and (d) the minimisation of insitu cement/sand rendering.

8.4.2g Safety-netting

Since the current budgetary process follows the three-year Rolling Plan procedures, it is recommended that the new method should be applied and be fully implemented within the span of a rolling plan period of three years. No University should experience a diffence of more than 10% plus or minus its last allocation within the first year of the implementation period. This is to act as a safety netting to remove the effect of sharp difference in allocation over the previous year.

8.4.2h Facilities Management, (FM)

The myriad of problems encountered in the surveys undertaken in this thesis tend to suggest that the maintenance problems involved may be better solved under the framework of a Facilities Management scheme. It should be noted that FM is a relatively new concept in the United Kingdom and has really not been introduced in Nigeria. It is therefore appropriate to review the state of art of FM in the United Kingdom in order to provide a pedestal for suggesting its application to the Nigerian University system.

Literature Review on Facilities Management

Facilities Management is about "management". It is about the integrated management of an amalgam of cost centres, which for most organizations equate to the large commitment. It is important to realize that Facilities Management departments generally have the mission statement to co-ordinate all aspects of facilities to positively assist their organizations achieve their strategic objectives. They will not be dealing with isolated aspects, such as just property, or just building maintenance - these are sectors of Facilities Management. Facilities Management is extremely broad in scope, covering at its simplest, the three sectors of: property, support services and information technology installations. Chart 8.1 "Functions of Facilities Management" is indicative of the range which may be encountered, (Owen, 1995).

Patient care is a critical concern of South Tees Acute Trust at Middlesbrough, and Facilities Management is central to this approach. South Tees has been pioneering patient-centred healthcare for the past ten years. The trust aims to be a "hotel for healthcare" in the provision of a patient-centred service. Facilities Management is key to the approach - which was why the trust set up its own Facilities Management division in 1992. The mission statement of the trust is *"To provide a continuing improving quality and commercially oriented cost effective service to our customers"* Its focus is on quality while acknowledging the commercial field in which Facilities Management works. In terms of achievements, how has the trust benefited from its approach to Facilities Management? The trust provides corporate benefits by releasing resources. For example, in two years, the trust has treated 12% more patients, employed over 200 more frontline staff, including 150 nurses, twelve clinicians and 40 paramedics. It has managed this at an additional overhead costs and no increase in Facilities Management budget, (Collingwood, 1995).

Nuffield Hospitals is the fourth largest charity in the United Kingdom and the largest whose sole objective is the provision of independent healthcare. It owns and operates 34 acute surgical hospitals throughout the United Kingdom. It was introduced to the concept of Facilities Management in 1989, just prior to it carrying out a radical review of its place in the market and its recent business performance. The organization was highly centralized with all real authority vested in corporate managers who both dictated and delivered all general management and support services. The company was, however, operating out of 32 small local hospitals, with each satisfying a discreet, self-contained market. To add to the shortcomings of the organization's structure, those at corporate office dictated the way their services would be delivered without an intimate knowledge for the market that was being served. In 1990, Nuffield Hospitals organized establishing a strong general management spine linking the Chief Executive with the Managers of each hospital and customers. The Planning and Facilities Directorate is organized with a three-tier structure to ensure that appropriate support is available at each level of the organization (see Chart 8.2). Facilities Management has supported the decentralization of core businesses by complementing its structure, but without losing the benefits that a global approach can bring to appropriate planning and implementation of common services. What it does, in fact, is to offer new philosophy and method of doing what has been done for years. Nuffield Hospitals have taken this opportunity and its business success has been enhanced, (Hennessy, 1995).

No one will predict the future with any great confidence especially with the rate of change seen around us. But inevitably it will be linked to the future demand for the professional facilities management services. Facilities Management concept developed in the late 80's when people started to look at property as an asset in which to undertake their business. With the investment crash in property during the 90's, the building user and his facilities manager came to forefront. Property owners became aware of the need to get more of existing space rather than simply building new or moving. The need to get more from less is the stock trade of the facilities manager. The following activities are covered under the umbrella of Facilities Management: building and measured surveys, project management, construction monitoring, buildings maintenance, insurance assessments and claims, preparing dilapidation claims (and defending!), carrying out building feasibility studies, and advising clients on health and safety issues. Facilities Management is indeed a holistic approach to property management and for a client to benefit most, there needs to be a long-term relationship. A good facilities manager will help influence property strategy and also make sure that maintenance problems get dealt at the right time, (Russel and Blackmore, 1995).

The type of industry in which the organization is established also plays a key role in the perception of Facilities Management. In simple terms, the following appear to be key issues: (i) compliance with health and safety (a legislation or contract issue), (ii) the cost control of services (an economic issue), (iii) the professionalism and general attitude in the Facilities Management supply industry (an organizational issue), (iv) the availability of stable employees (a labour issue), (v) an effective environmental policy (a legislation or contract issue), (vi) the expertise needed to create the working environment (a technological issue), and (vii) the ability to monitor and control the environment effectively (a technological issue), (BIFM, 1995).

Employing a professional Facilities Management company can provide considerable savings through optimisation of staff resources. A multi-stalling approach from the facilities management company provides not only a more effective use of human resources but also access to a higher level of expertise in contract delivery. Contracting out does not mean abrogating responsibilities. Building and property are registered to BS EN 150 9000 quality standards for all its services and requires its suppliers to operate quality systems. In practice, this means taking a proactive role in monitoring the performance standards of other service providers, (Dolan, 1995).

The organizations of the properties services in Lloyd's building of London is split into five departments - facilities, buying, contracts and estates; room services, catering, and security. The majority of the services are contracted out to suppliers, unless there is a strategic or economic justification for retaining the function "in house". Each service is scrutinized to ascertain whether there are vertical or horizontal economies to be gained by outsourcing and, where that is the case, the standardized contract procedure adopted by Lloyd's over the last nine years is used. This is contrary to some organizations which adopt contracting out as a doctrine unless the service is held to be a core activity. One of the major concerns facing Lloyd's as a large scale space user is how to plan strategically for the increasing impact of technology. There is a widespread and intensive use of electronic storage of data computer communication links throughout the organization. In the short-term, until the full impact of how technology will change the business process is known, the most important feature of all Lloyd's property portfolio is that these be flexible to allow for the inevitable organizational changes which will follow, (Phillips, 1995).

The following are summaries obtained from the above literature reviews of Facilities Management as practised in the United Kingdom: (1) Facilities Management is extremely broad and covers three sectors - property, support services and IT installations; (2). The general mission statement is to provide a continuing, improving quality and commercially-oriented cost effective service to customers; (3). There is a need to establish a strong general management spine linking the Chief Executive with the Managers; (4). The main functions of Facilities Management are: building and measured surveys, maintenance, insurance assessment and claim, building feasibility studies and advise to clients on health and safety issues (5.) Employing a professional Facilities Management company is advisable, it optimizes staff resources; and, (6.) There should also be flexibility to allow for inevitable organizational changes which may follow.

In the case of the Federal Universities in Nigeria, the deterioration of the building conditions may be attributed, apart from poor funding criteria, to the lack of effective management of the existing facilities. Therefore, borrowing from the present worldwide concept of Facilities Management, it is recommended that Facilities Management be introduced into the works services systems of all the Federal Universities. Essentially, independent Facilities Management outfits should be appointed to take the load off the Works Departments who are not adequately and suitably staffed. Facilities Management firms of each of the Federal Universities should be able to develop data storage profiles that can be accessed by the respective client Works Departments. There should be sub-central Facilities Management data system installed separately for each set of "Generation of Universities" as well as a national Facilities Management data bank at the NUC Headquarters at Abuja. Weighted national data indices could then be distributed to all the Federal Universities. (see Chart 8.3).

8.5 AREAS FOR FURTHER STUDIES

1) A Programme of research should be undertaken to investigate the full potential of using simulation modeling approach to determine the most optimum strategy for maintenance work on a generation by generation basis. This should lead to a position where a clear policy directive can be given by the Central Co-ordinating Agency as to the direction or strategy to be adopted by the Universities each year.

2) A programme of research work should be undertaken to develop and test fully, the implementation of the data collection methodology described in Chapter 6 for all the categories of buildings in the State Universities. This will confirm the universal application of the system across the Universities irrespective of ownership.

3) A programme of research work should be undertaken to develop the integrated Database for the result of all the condition surveys of existing building stock in the Nigerian University System. This will then serve as an integrated inventory of existing facilities and their conditions in all the Nigerian University System. Computer software should then be developed to facilitate report generations for planning and research purposes.

4) The data obtained from the buildings at the University of Nigeria, Nsukka tended to drastically affect the modeling system envisaged and gave rise to what was described in the text, as the "*Nsukka Effect*". That resulted in the clearing off of the data from the model to make the model effective. The condition of building stocks at the University of Nigeria, Nsukka require special funding allocation in order to successfully accomodate Nsukka buildings into an acceptable model in future.

5) Special investigations should be carried out into the cost effectiveness or otherwise of using Facilities Management (FM) techniques for property and maintenance management in all the Federal Universities in Nigeria. Also, research should e carried out on the possibility of establishing a modern maintenance information system in all the Federal Universities with a central database at the NUC.

6) Investigating the possibilities of introducing some modified versions of the models derived at the research for use in:- (i) state and privately-owned universities in Nigeria, (ii) other tertiary institutions in Nigeria e.g polytechnics and colleges of Education, and, (iii) universities and centres of higher education in other African countries.

Chart 8.1: Functions of facilities management

Law
* Contract
* Employment
* Property
* Safety and Health

HUMAN RESOURCES
* Recruitment
* Pension Scheme
* Training
* Benefits Packages

Information Technology
* Research and Development
* Operations
* Maintenance
* Management Information
* Cable Management
* Help Desk

BUILDING REAL ESTATE
* Property Asset Management
* Site Selection
* Relocation
* Lease Management
* Acquisition
* Disposal
* Building Management
* Building Inspection

MARKETING
* Corporate Image
* Product Styling
* Sales
* Public Relations
* Market Research

SUPPORT SERVICES
* Mail Services
* Fleet Car
* Catering
* Reception
* Housekeeping
* Office Administration
* Refuse Disposal
* Reprographics
* Security
* Stationery
* Travel
* Vending
* Furniture
* Purchasing
* Car Park Management
* Horticulture
* Porterage

BUILDING MAINTENANCE SERVICES
* Maintenance Management
* Structure and Fabric Maintenance
* Services Maintenance
* Finishes Maintenance
* External Areas Maintenance
* Security
* Telecomunications
* I.T. Infrasture
* Energy Management
* Environment Surveys
* Health and Safety

BUSINESS MANAGEMENT
* Strategic Studies
* Feasibility Studies
* Budget Preparation
* Decision Support
* Productivity Improvement
* Organisation Change
* Standards Development
* Planning: 1-2 Year plans
  3-5 Year plans
  10 year + plans
* Training
* Quality Control
* Disaster Recovery Planning

OPERATIONS
* Product Design/Development
* Product Testing

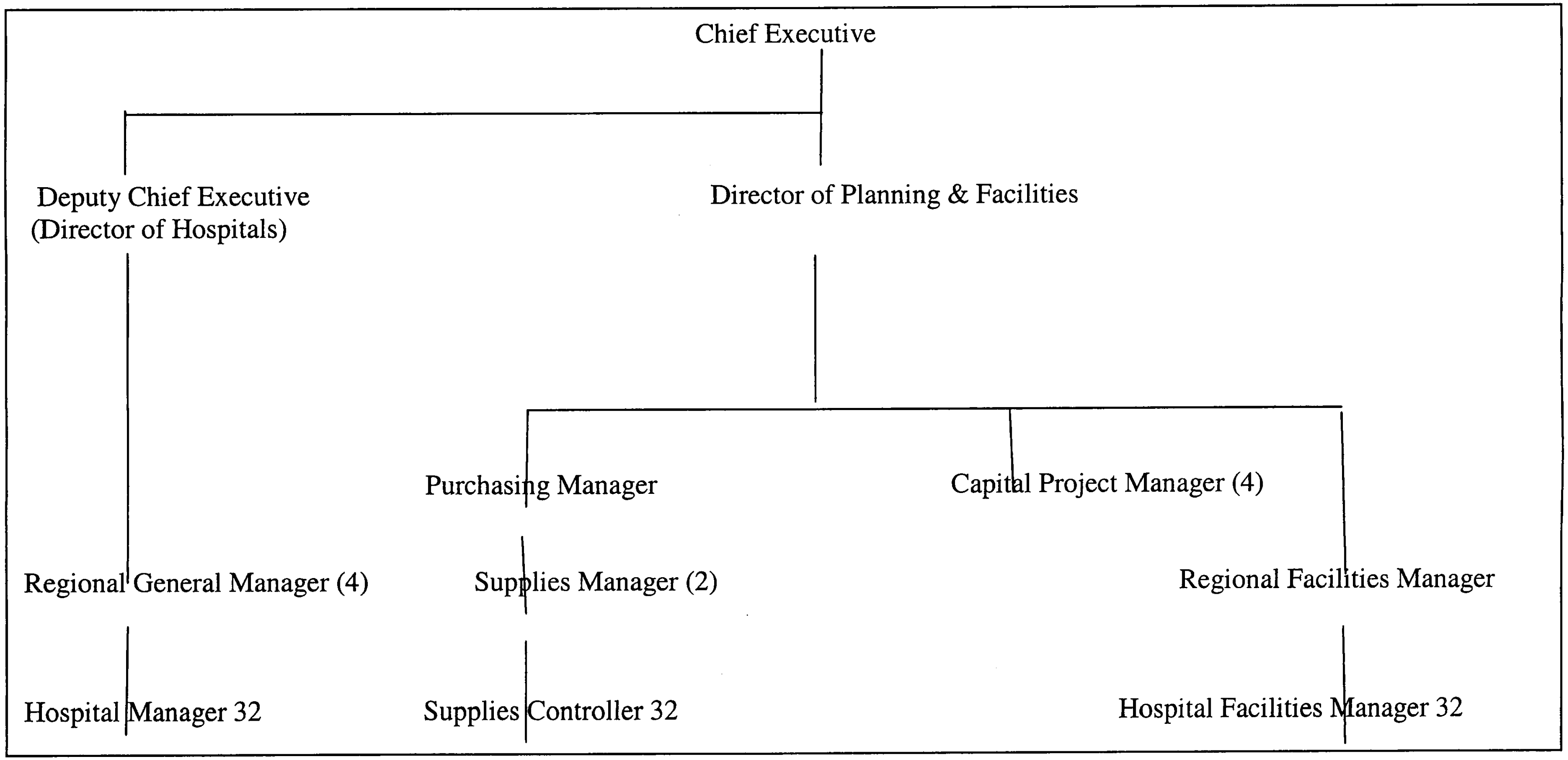
BUILDING CAPITAL WORKS
* Architectural Design
* Space Planning
* Structural Design
* Mechanical and Electrical Design
* Interior Design
* Project Management
* Planning
* Statutory Complaince
* Specification Preparation
* Competitive Tender Processing

FINANCE
* Accounting
  - Tax
  - Audit
  - Strategic
* Banking
* Invoicing
* Corporate Finance
* Building Cost Control
* Company Secretariat
* Tailored Financial Reporting

CHURN-MANAGEMENT
* Interior Space Planning
* Interim Space Allocation
* Interim Space Inventory
* Interim Space Forecasting
* Furniture and Partition Acquisition
* Post Occupancy Evaluation

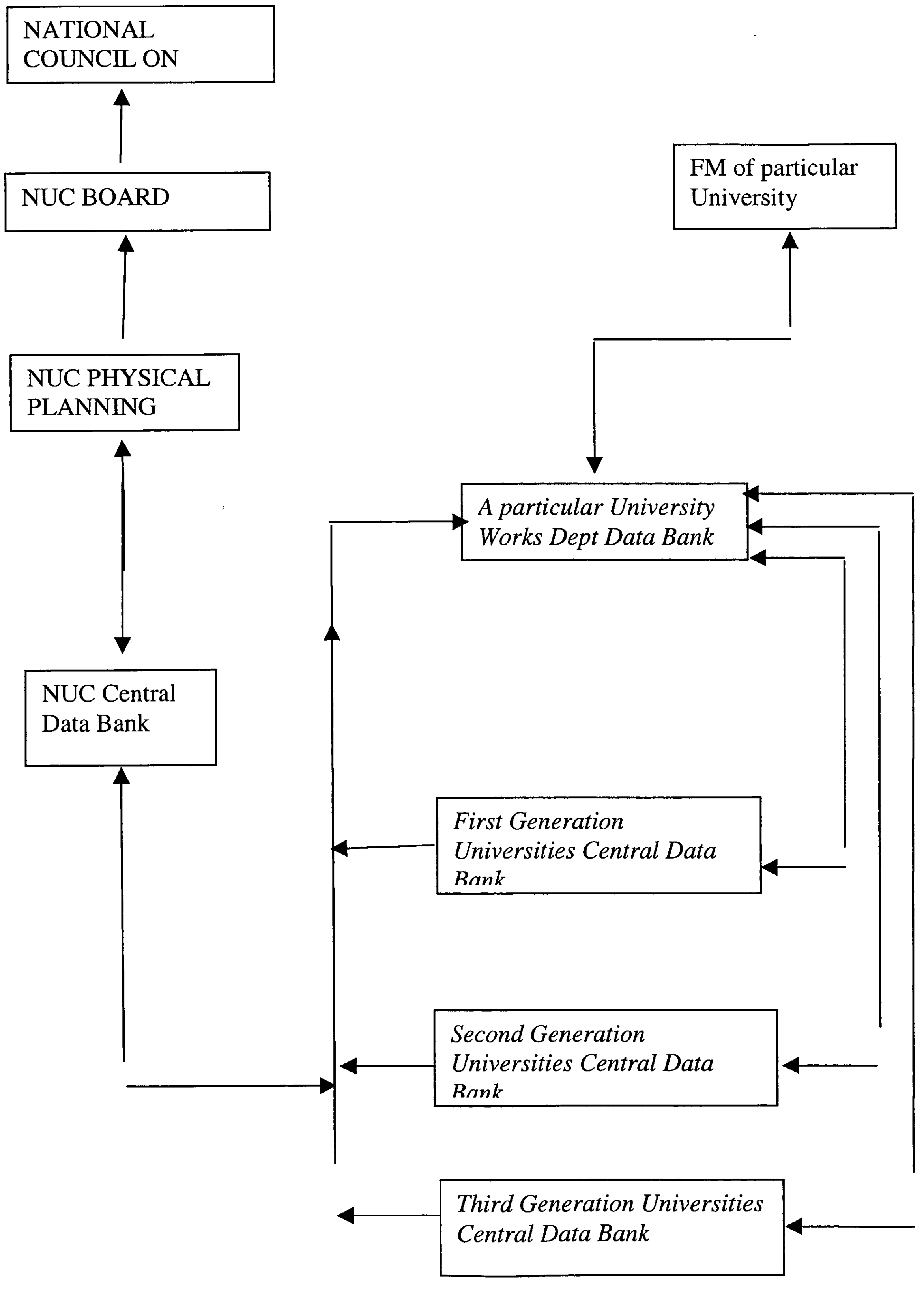
Source: Owen, D. CSM SUPPLEMENT – JUNE 1995, p iii

Chart 8.2: The Organisation of the planning and facilities directorate



Source - CSM SUPPLEMENT - JUNE 1995

Chart 8.3: Suggested New Physical Development Information System For Nigerian University System



8.6 SUGGESTIONS FOR IMPLEMENTING THE RECOMMENDATIONS

The following measures are suggested for implementing the recommendations.

a) Set up an *ad-hoc* body to study the findings and recommendations emanating from this research.

b) Convene conference/workshops of the various Physical Planning Divisions of all the Federal Universities in Nigeria to discuss the points raised in this thesis with a view to seeking their opinion for any inputs that would facilitate decision making, framework as well as obtaining a draft situation report for the preparation of a Government White Paper on the Physical Development Policy of the Federal Universities in Nigeria. Such activities should also allow for the presence of the state universities, polytechnics and colleges of education who could attend either as observed, or full-fledged participants.

c) Before the implementation of the content of a proposed Government White Paper, Physical Planning Units should be given adequate training on the operation modules.

d) The National Universities Commission should participate in the screening of Facilities Management Contractors/Consultants to be appointed for each University in order to ensure standards.

e) Data inflow from the universities to the National Universities Commission's proposed central data bank should be on stated periods e.g. monthly, quarterly, and annually.

f) The suggested models in this thesis as well as the information system flow network should be subjected to periodic reviews say, every three years.

g) Provide adequate funds to sponsor the various researches suggested in this text. It should maintain sufficient contacts with some of the relevant research institutions inside and outside Nigeria, e.g. The Nigerian Building

Research Institute, the Nigerian Institute of Quantity Surveyors, the British Research Establishment (BRE) and the British Maintenance Cost Information Services (BMCIS). Appropriate linkages with UNESCO and the World Bank as well as the British University System should also be explored for matters of professional advice, particularly, as regards the acquisition of foreign loans and foreign expertise.

ANNEX A: NUMERICAL ILLUSTRATION OF THE DERIVED FORMULA AS SHOWN ON PAGE 257

For example: The parameters for a lecture theatre in the University of Benin were computed as follows:

building code	=	Up2/2
X1	=	5,719
X2	=	667,489
X3	=	4
X4	=	817
X5	=	3,268
Cost of repairs	=	1130979+47.88 (5,719)-0.0220 (667,489)
	=	+849 (4)- 468 (817)+121 (3,268)
	=	1130979+273,825.72-14,684.76
	=	+3396-382,356+395,428
	=	₦1,406,587.96
	=	$17,582.35 @ ₦80.0 = $1.0 in 1997

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LIST OF APPENDICES

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APPENDIX

DEVELOPMENT OF FUNDING MODEL FOR ALLOCATING CAPITAL GRANTS TO NIGERIAN FEDERAL UNIVERSITIES:

Minutes of the meeting held with Prof. Donald E. U. Ekong, former Executive Secretary, Association of African Universities (AAU)

Date: Wednesday, 9th July, 1997

Venue: Director's Office, Department of Physical Planning & Development, NUC Abuja- Nigeria.

Time: 11:50 am.

Present:

1.	Prof. Akin Akindoyeni	-	Director of Physical Planning NUC
2.	Prof. Donald E. U. Ekong	-	Past Executive Secretary, Association of African Universities (AAU), based in Accra, Ghana.
3.	Mal. I. Abdullahi	-	Deputy Director (NUC), the Researcher.

1.0 OPENING REMARKS:

In his opening remarks, Prof. Akin Akindoyeni welcomed Prof. Ekong to the NUC and briefed him on the objectives of the Research on the development of Funding Model for the allocation of Capital grants to the Federally funded Universities in Nigeria. He informed that the idea of holding the meeting with Prof. Ekong was to share his experience as a former Vice Chancellor in Nigeria and as the immediate past Executive Secretary of the AAU. He explained that the Researcher had prepared a working paper which would be used to guide the meeting and thanked Prof. Ekong for accepting to participate.

Responding Prof. Ekong thanked the Director and informed that even though he might not have the whole answers to the questions, he promised to share his personal experience on the issues to be raised.

2.0 Adequacy of Capital Funding to the University System:

(I) Prof. Ekong informed that since he had no specific figures from other Countries on capital allocation, he was not in a position to comment on the adequacy or otherwise of the N1.6Billion (about US$ 20.0Million) @N80.00/1$ allocated to Federal Universities in 1996, by the Nigerian Government.

2.1 **Allocation of Capital Funds on year of Establishment:**

(1) Prof. Ekong considered the method to be unfair to the Universities since they have different problems.

(2) Treating every body equally does not mean treating them fairly.

(3) On how the uniform allocation by generation affects execution of projects in the late seventies and early eighties, during his time as a Vice Chancellor, Prof. Ekong stated that:-

(a) During that period, there were more resources available to the Universities than their Executive capacities to spend.

(b) The capital grant was given as a one line vote for the University to decide where to allocate and was not project specific.

(c) The urge then was to build new structures to develop the Universities.

(4) In other African Countries like Ghana, Physical development was being handled directly by the Government and not by the individual Universities or any Organisation.

(5) In South Africa, the Government provides certain percentage of the capital funds for a particular project, the University then raises the remaining by fund raising through:

(a) Donation from private sector
(b) Endowment; and
(c) Other gifts.

(6) In other parts of the World such as the UK, the Government may provide substantial cost of a particular project that is fully justified with all the necessary documentation on space utilisation.

3.00 **Co-ordination of University Education:**

(1) Prof. Ekong informed that in the whole of African Countries, there is no other Country with such a well organised centrally co-ordinating body like the NUC.

(2) The only other developing Country with such a body was India. The University Grant Commission of India was a large body which was well organised and could be regarded as the best in the developing Countries. The NUC in Nigeria would then follow.

(3) Other African Countries were just trying to establish such a body as:

(a) Ghana which has recently set up a body known as `Tertiary Education Commission'

(b) Kenya also established a `Tertiary Education Commission'

(c) South Africa was in the process of establishing Higher Education Council with a model similar to that of Australia. The white paper approving the establishment was only out about two weeks from the time of the meeting.

The distinguishing factor in all these African Countries is that the body will only be responsible for programmes co-ordination but no fund allocation. The fund allocations are to be made by the respective Ministries.

(4) On central control, Prof. Ekong stated that it has been practised in Nigeria and does not work well. He therefore recommended maintaining the system of giving capital funds to the Universities instead of controlling it at the centre (NUC).

4.00 **Growth rates:**

(1) On the issue of growth, Prof. Ekong informed that there were a general observations by the International Communities and bodies like the World Bank that African Universities were growing at faster rates.

(2) He categorised that African Countries could be divided into two groups when discussing growth; as follows:

(a) Those Countries whose emphasis to University Education was on quality, like Ghana, Tanzania and Zambia. He cited an example with the University of Ghana which was established about the same time with that of Ibadan in Nigeria (1948) but had a total student population of only 4,000 in 1988 whereas Ibadan had about N15,000 students during the same period.

(b) Others like Nigeria have their emphasis on access rather than quality, and therefore admit students any how. He stressed that Nigerian Universities grow faster than the economy would have fully supported them.

5.00 **Parameters for allocating capital funds:**

(1) On the issue of parameters, Prof. Ekong observed that; when resources are limited, the need for sensible planning has to be paramount.

(2) he therefore advocated the use of:

(a) space norms/student
(b) space utilisation;
(c) available spaces; and
(d) justification for projects to be the ideal parameters to be used for capital fund allocation in the Universities.

6.00 **Maintenance culture of Physical facilities:**

(1) On maintenance culture, Prof. Ekong observed that it was a serious problem not only in Nigeria but all over the African Countries. He maintained that budgets for Physical facilities where made annually without the corresponding amounts for maintaining them.

(2) Rather than maintaining physical facilities, regularly, African Countries prefer allowing the facilities to deteriorate to the extend that they would prefer to replace them. He cited the example of a National Conference Centre in Ghana (Kwami Nkrummer Centre) which was proposed to be rehabilitate and used for a non alien movement meeting at one time. But instead of rehabilitating it when the assessment was done, a new one was constructed for the occasion.

(3) He therefore advised on the need for our Universities to pay more attention to the maintenance of their physical facilities.

7.00 **Lesson from experience:**

(1) On lesson from experience, Prof. Ekong noted that lack of continuity in the Universities administration was responsible for lack of progress in the system.

(2) He observed that the short tenure of Vice Chancellors and Councils, constituted some of the problems. He noted that in South Africa, a University Council could consider and ask a Vice Chancellor who has done extremely well to continue at the expiration of his term of office, which enhanced their system.

(3) Similarly, in the developed Countries like the UK, a Vice Chancellor once appointed stays on the post until his retirement. That concept he argued, ensured stability in their system.

(4) Prof. Ekong advised on the development of a system which would provide more incentive for rewarding hard work and efficiency.

(5) He also advised on greater autonomy to be given to the Universities.

(6) He further advised on the need for a review of the terms of office for both Council members, Vice Chancellors and other Principal officers.

8.00 **Closing Remarks:**

In his closing remarks, the Researcher thanked Prof. Ekong and requested for his permission to use the minutes as reference materials.

Responding, Prof. Ekong expressed appreciation for the fruitful discussions and granted the permission to use the minutes as reference materials.

[redacted]

Ibrahim Abdullahi
(The Researcher).

APPENDIX 2

NATIONAL UNIVERSITIES COMMISSION

EXECUTIVE SECRETARY
PROF. IDRIS A. ABDULKADIR

Cablegram: UNICOMM LAGOS.
Telephone: (09) 5233185
(09) 5233176 - 81 (6 Lines)
Telefax: (09) 5233520.

AJA NWACHUKWU HOUSE
PLOT 430 AGUIYI-IRONSI STREET,
MAITAMA DISTRICT,
P.M.B. 237, GARKI G.P.O.,
ABUJA - NIGERIA

Our Ref.: NUC/ES/216/VOL.XVIII/189

Your Ref.: ____________

OFFICE OF THE
EXECUTIVE SECRETARY

11 May 1996

Vice Chancellors
All Federal Universities

DEVELOPMENT OF NEW FUNDING MODEL FOR ALLOCATING CAPITAL GRANTS TO THE FEDERALLY FUNDED UNIVERSITIES IN NIGERIA:

In line with the Institutional Reforms currently going on in the Nigerian University System, the National Universities Commission is undertaking a study within the system with a view to developing a new funding Model for Allocating Capital Grants to the Federal Universities.

The study is expected to address the following issues:

1. Capital Grant Allocation using year of establishing the Universities known as the Generation.
2. The percentage ratios to be allowed for new Capital Projects and Rehabilitation/Maintenance of the existing facilities.
3. Additional parameters to be considered for capital allocation.

The Physical Planning Department of the NUC has been charged with the responsibility for this study and the Director will be contacting you for necessary data.

Please give your maximum support to ensure the success of the study.

Sincerely,

[redacted]

Executive Secretary

APPENDIX 3/1

NATIONAL UNIVERSITIES COMMISSION

SECRETARIAT

EXECUTIVE SECRETARY
PROF. MUNZALI JIBRIL

Telephone: (09) 5233176 - 81 (6 Lines)
Telefax: (09) 5233520.

AJA NWACHUKWU HOUSE
PLOT 430 AGUIYI-IRONSI STREET,
MAITAMA DISTRICT,
P.M.B. 237 GARKI G.P.O.,
ABUJA - NIGERIA

NUC/PPD/A.200

12th May, 1997

TO:

ALL VICE CHANCELLORS - FEDERAL UNIVERSITIES AND
DIRECTORS OF INTER-UNIVERSITY CENTRES.

INVENTORY OF PHYSICAL FACILITIES
IN NIGERIAN FEDERAL UNIVERSITIES.

Please refer to our earlier radio message on the 21/3/97 pertaining to CPC/CVC's request for an update of Infrastructural facilities in the Federal Universities dated 26th November, 1996.

The NUC is updating its database of physical facilities in order to advise the CVC. I therefore write to request for an update on the Inventory of physical facilities in your University/Centre.

The format of the information being requested is shown in the attached form and is to cover the following typography of buildings:-

(i) UP 1 Admin

(ii) UP 2 Academic
UP2/1-Lecture theatres
UP2/2-Classroom Blocks
UP2/3-Laboratories
UP2/4-Workshops
UP2/5-Studios
UP2/6-Libraries

(iii) UP 3 Teaching Support

(iv) UP 4 Estate Development
UP 4/1-Offices
UP 4/2-Workshops
UP 4/3-Stores

(v) UP 5 Community
UP 5/1-Health
UP 5/2-Staff Clubs
UP 5/3-Student Centres

(vi) UP. 6 Residential Accommodation
UP 6/1-Staff Accommodation
UP 6/2-Student Accommodation

The above typography of buildings is to be strictly adhered to. Please ensure that each form carries the correct typography for accurate database records.

Your submission should reach the NUC on or before Monday, 16th of June, 1997.

[redacted]

[redacted]

Director of Physical Planning & Development.

APPENDIX 3/3

INVENTORY OF PHYSICAL FACILITIES IN THE FEDERAL UNIVERSITIES/INTER- UNIVERSITY CENTRES OF NIGERIA

BUILDING TYPE UP ....

S/NO	FACULTY	BLOCK NO	NAME OF BUILDING	NO. OF BLOCKS IN THE BUILDING	USABLE FLOOR AREA FOR FACULTY	YEAR OF COMMISSIONING	LAST DATE OF RENOV.

NATIONAL UNIVERSITIES COMMISSION

xecutive Secretary:- Prof. Munzali Jibril
irector:- Rev. (Prof.) Akin Akindoyeni mni
elephone:- (09) 5233176 - 81 (6 Lines).
elefax:- (09) 5233520.

Aja Nwachukwu House,
Plot 430 Aguiyi-Ironsi Street,
Maitama District,
P.M.B. 237, Garki G.P.O.,
Abuja - Nigeria.

ur Ref.: NUC\PPD\A.200

our Ref.:

Office Of The Director
PHYSICAL PLANNING AND DEVELOPMENT
DEPARTMENT

27-06 19 97

ALL VICE CHANCELLORS
FEDERAL UNIVERSITIES AND
DIRECTORS OF INTERN-UNIVERSITY CENTRES

INVENTORY OF PHYSICAL FACILITIES IN NIGERIAN FEDERAL UNIVERSITIES:

CONDITION SURVEY

1.00 Further to our letter Ref: NUC\PPD\A200 of 12th May, 1997 and your submission of the NUC would like to have the assessment of the present Physical condition of the buildings for the following Typography:

(i) UP1 Admin
(ii) UP2 Academic

UP2\1	Lecture theatres
UP2\2	Classroom Blocks
UP2\3	Laboratories
UP2\4	Workshops
UP2\5	Studios
UP2\6	Libraries

(iii) UP3 Teaching support

The format of the information being requested now is the same as in the first case except for the two (2) additional columns to indicate the ;building grade and the estimated cost of rehabilitation as shown in the attached form. A separate for is to be completed for each typography of building as in the first case also.

2.00 CONDITION SURVEY

The University\Centre is expected to conduct a condition survey with a view to physically assess the present state of each of the buildings.

The assessment would include that of the frame elements, Roof structure and covering, plumbing and Electrical fittings as well as the state of the finishing at the end of the elemental assessment, each building will then be classified into one of the following grades:

Grade 1	The building is as new with the expectancy that with proper maintenance, the building will provide a satisfactory standard of service.
Grade 2	The building is in a satisfactory condition with initial deterioration signs which would require smaller amount of money to attend to
Grade 3	The building is safe but signs of fast deterioration are shown on some of the elements and would require sizeable amount of money to repair.
Grade 4	The building is operational but major repairs and replacement of key elements will be necessary within a reasonable short period.
Grade 5	The building is in operable and requires work on many elements
Grade 6	The building is in operable and unsafe until major elements are replaced.
Grade 7	The building is in operable and unsafe with high risk of immediate breakdown. It requires urgent expenditure to save it from collapsing.
Grade 8	The building has collapsed already and most of the elements have to be replaced.
Grade 9	The building has never been completed.

3.00 ESTIMATED COST OF REHABILITATION

Having assessed and graded the condition of each building, the University\Centre is expected to provide estimated cost of rehabilitating the building to take it to the most functional level.

The assessment of the building condition, grading and estimating the cost of rehabilitation would constitute the second phase of the database.

The information is to guide the Government to finalising policy decisions on the Institutional Reforms for the University system.

Your submission should therefore reach the NUC on or before Thursday 31st July, 1997.

[redacted]

Ag. Director Physical Planning & Development

NATIONAL UNIVERSITIES COMMISSION

INVENTORY OF PHYSICAL FACILITIES IN THE FEDERAL UNIVERSITIES\INTER-UNIVERSITY CENTRES OF NIGERIA.

BUILDING TYPE ....

RESULT FROM CONDITION SURVEY

S\N	FACULTY	BLOCK NO.	NAME OF BUILDING	NO. OF BLOCKS IN THE BUILDING	USABLE FLOOR AREA FOR FACULTY	YEAR OF COMMISIONING	LAST DATE OF RENOVATION	GRADE FROM THE CONDITION SURVEY *	ESTIMATED COST OF REHABILITATION	REMARKS

* Please see over leaf for the clarrification of Grades.

APPENDIX 4

NATIONAL UNIVERSITIES COMMISSION

SECRETARIAT

EXECUTIVE SECRETARY
PROF. MUNZALI JIBRIL

Telephone: (09) 5233176 - 81 (6 Lines)
Telefax: (09) 5233520.

AJA NWACHUKWU HOUSE
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MAITAMA DISTRICT,
P.M.B. 237 GARKI G.P.O.,
ABUJA - NIGERIA

INVENTORY OF PHYSICAL FACILITIES IN THE FEDERAL UNIVERSITES/INTER-UNIVERSITES CENTRES IN NIGERIA

Annex I

VERIFICATION CERTIFICATE

NAME OF UNIVERSITY: ILORIN

ADDRESS: P. M. B. 1515, ILORIN

DATA OF VERIFICATION: OCTOBER, 1998

I confirm that the Data on this University as contained in the attached sheets are correct.

Name of Verifier: Engr A. A. ADESIYUN

Rank: DIRECTOR OF PHYSICAL PLANNING

Signature: [redacted]

Name of NUC Project Officer: Eba J. Ike

Signature: [redacted]

Date: 5th November '98

APPENDICES 5 AND 6

PLEASE SEE APPENDIX 3/ 1 – 2 AND APPENDIX 3/ 4 - 5

NATIONAL UNIVERSITIES COMMISSION

DEPARTMENT OF PHYSICAL PLANNING & DEVELOPMENT

TECHNICAL MEETING ON THURSDAY 26TH JUNE, 1997 INVENTORY OF PHYSICAL FACILITIES IN THE FEDERAL UNIVERSITIES (PHASE 11)

CONDITION SURVEY

The attached sheet provides the information on School of Environmental Sciences at the Federal University of Technology, Yola. The information provided include; the type of building, available floor area, the year of Commissions and the last date of renovating the building (if any).

The next stage of the database is to collect information on the condition of the buildings. This is to be provided by the Universities after conducting a condition survey and Physical assessment of the present state of each of the buildings. The assessment would include that of the frame elements, roof structure and covering plumbing and electrical fittings as well as the state of the finishing. At the end of the elemental assessment, each building will then be classified into one of the following grades:

Grade 1	*The building is as new with the expectancy that with proper maintenance, the building will provide a satisfactory standard of service.*
Grade 2	*The building is in a satisfactory condition with initial deterioration signs which would require ~~smaller~~ small amount of money to attend to*
Grade 3	*The building is safe but signs of fast deterioration are shown on some of the elements and would require sizeable amount of money to repair.*
Grade 4	*The building is operational but major repairs and replacement of key elements will be necessary within a reasonable short period.*
Grade 5	*The building is in-operable and requires work on many elements*
Grade 6	*The building is in-operable and unsafe until major elements are replaced.*
Grade 7	*The building is in operable and unsafe with high risk of immediate breakdown. It requires urgent expenditure to save it from collapsing.*
Grade 8	*The building has collapsed already and most of the elements have to be replaced.*
Grade 9	*The building has never been completed.*

2.00 *ESTIMATED COST OF REHABILITATION*

Having assessed and graded the condition of each of the buildings, the University is expected to provide estimated cost of rehabilitating the building to bring it to a functional level.

The assessment of the building condition, grading and estimating the cost of rehabilitation would constitute the phase 11 of the inventory of Physical facilities data collection.

The project officers are therefore expected to explain to the University officials to ensure greater accuracy.

[redacted]

I. Abdullahi

c:\document\physplan\corres\surdis.rpt

INVENTORY OF PHYSICAL FACILITIES IN THE FEDERAL UNIVERSITIES/INTER-UNIVERSITY CENTRES OF NIGERIA

APPENDIX 9/1

UNIVERSITY CODE:183

UNIVERSITY: FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE

S/NO	FACULTY	BLOCK NO	NAME OF BUILDING	NO OF BLOCK IN BUILDING	USABLE FLOOR AREA	YEAR OF COMM	LAST DATE RENOVATED	CONDITION OF BUILDING 1997	CONDITION OF BUILDING 1998	ESTIMATED COST OF REPAIRS 1997	ESTIMATED COST OF REPAIRS 1998
98	CENTRAL ADMIN.	UP1/1	ADMIN. BUILD.	1	381.80	1986	1986	3		1,000,000.00	
99	CENTRAL ADMIN.	UP1/1	OLD SENATE.WING	1	0.00	1986	1986	3		400,000.00	
100	CENTRAL ADMIN.	UP1/1	OLD VC'S WING	1	0.00	1986	1986	3		400,000.00	
101	CENTRAL ADMIN.	UP1/1	OLD REG. COMPL.	4	782.06	1986	1996	2		100,500.00	
102	CENTRAL ADMIN.	UP1/1	OLD ADMIN. BLD	4	354.00	1986	1996	2		0.00	
103	CENTRAL ADMIN.	UP1/1	NEW SENATE BLD.	1	2,027.04	1995	1995	1		3,000,000.00	
104	CENTRAL ADMIN.	UP1/1	SECURITY BLCK.	1	60.00	1996	1997	2		200,000.00	
	TOTAL FOR THIS CATEGORY			**13**	**3,604.90**					**5,100,500.00**	
105	SCIENCE	UP2/1	BIO. CHEM	1	799.00	1986	1986	2		100,500.00	
106	SCIENCE	UP2/1	BIOLOGY BLOCK	1	211.00	1984	1986	2		100,500.00	
107	AGRICULTURE	UP2/1	FISHERIES& WOOD	2	375.00	1986	1986	3		1,000,000.00	
108	ENGINEERING	UP2/1	SET BLOCK	2	381.00	1986	1986	3		1,000,000.00	
109	SCIENCE	UP2/1	LECTURE THEA AB	2	762.00	1988	1988	2		5,000,000.00	
	TOTAL FOR THIS CATEGORY			**8**	**2,528.00**					**7,201,000.00**	
110	SCIENCE	UP2/2	ELECT. BLD.	2	1,228.06	1986	1988	2		8,000,000.00	
111	ENGINEERING	UP2/2	SCH. BLCK A1	2	1,908.97	1990	1990	3		15,000,000.00	
112	ENGINEERING	UP2/2	AGRIC. ENGR.	2	490.00	1986	1986	3		1,000,000.00	
113	SCIENCE	UP2/2	SCH. BLOCK 1B	1	396.16	1990	1990	3		0.00	
	TOTAL FOR THIS CATEGORY			**7**	**4,023.19**					**24,000,000.00**	
114	SCIENCE	UP2/3	OLD CHEM. BLOCK	2	345.00	1984	1986	2		100,500.00	

INVENTORY OF PHYSICAL FACILITIES IN THE FEDERAL UNIVERSITIES/INTER-UNIVERSITY CENTRES OF NIGERIA

UNIVERSITY CODE:183

UNIVERSITY: FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE

S/NO	FACULTY	BLOCK NO	NAME OF BUILDING	NO OF BLOCK IN BUILDING	USABLE FLOOR AREA	YEAR OF COMM	LAST DATE RENOVATED	CONDITION OF BUILDING 1997	1998	ESTIMATED COST OF REPAIRS 1997	ESTIMATED COST OF REPAIRS 1998
115	SCIENCE	UP2/3	NEW CHEM. BLOCK	2	416.00	1986	1996	2		100,000.00	
116	SCIENCE	UP2/3	PHYSIC BLOCK	1	574.00	1984	1986	2		2,000,000.00	
117	AGRICULTURE	UP2/3	ANIMAL PROD.W/S	1	117.00	1986	1986	3		1,000,000.00	
118	AGRICULTURE	UP2/3	CROP.PRODUCTION	1	360.00	1986	1986	3		1,000,000.00	
119	SCIENCE	UP2/3	BIOLOGY BLOCK	1	540.00	1986	1986	3		100,500.00	
120	ENGINEERING	UP2/3	GEOLOGY BLOCK	1	540.00	1986	1986	3		100,500.00	
121	SCIENCE	UP2/3	SCI.PHAS.1&2	2	2,734.00	1996	1996	1		4,000,000.00	
	TOTAL FOR THIS CATEGORY			11	**5,626.00**					**8,401,500.00**	
122	AGRICULTURE	UP2/4	WOOD W/SHOP	1	384.00	1986	1986	3		2,000,000.00	
123	AGRICULTURE	UP2/4	MACHINE SHOP	1	384.00	1986	1986	3		2,000,000.00	
	TOTAL FOR THIS CATEGORY			2	**768.00**					**4,000,000.00**	
124	TEACHING SUPPORT UNIT	UP2/6	LIBRARY BLOCK	2	1,048.95	1984	1986	4		6,000,000.00	
125	TEACHING SUPPORT UNIT	UP2/6	LIBRARY LB 2	1	115.02	1984	1986	4		0.00	
	TOTAL FOR THIS CATEGORY			3	**1,163.97**					**6,000,000.00**	
126	ENGINEERING	UP3/1	SCH BLCK A1	1	1,687.33	1990	1990	3		15,000,000.00	
127	AGRICULTURE	UP3/1	SCH. BLCK 1B	1	1,737.89	1990	1990	3		10,000,000.00	
128	TEACHING SUPPORT UNIT	UP3/1	COMP. CENTRE	2	380.00	1991	1991	2		500,000.00	
129	TEACHING SUPPORT UNIT	UP3/1	FIELD	0	262.00	1986	1986			0.00	
	TOTAL FOR THIS CATEGORY			4	**4,067.22**					**25,500,000.00**	

INVENTORY OF PHYSICAL FACILITIES IN THE FEDERAL UNIVERSITIES/INTER-UNIVERSITY CENTRES OF NIGERIA

UNIVERSITY CODE:183 UNIVERSITY: FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE

S/NO	FACULTY	BLOCK NO	NAME OF BUILDING	NO OF BLOCK IN BUILDING	USABLE FLOOR AREA	YEAR OF COMM	LAST DATE RENOVATED	CONDITION OF BUILDING 1997	CONDITION OF BUILDING 1998	ESTIMATED COST OF REPAIRS 1997	ESTIMATED COST OF REPAIRS 1998
130	PUBLIC SERVICE UNIT	UP4/1	OFFICES	3	380.00	1986	1986	3		500,000.00	
	TOTAL FOR THIS CATEGORY			**3**	**380.00**					**500,000.00**	
131	PUBLIC SERVICE UNIT	UP4/3	WORK SHOP	1	80.00	1986	1986	3		500,000.00	
132	PUBLIC SERVICE UNIT	UP4/3	STORES	2	280.00	1986	1986	3		500,000.00	
	TOTAL FOR THIS CATEGORY			**3**	**360.00**					**1,000,000.00**	
133	PUBLIC SERVICE UNIT	UP5/	RACKET HALL	1	199.00	1987	1987	5		500,000.00	
	TOTAL FOR THIS CATEGORY			**1**	**199.00**					**500,000.00**	
134	PUBLIC SERVICE UNIT	UP5/1	HEALTH CENTRE	3	418.39	1986	1991	5		200,500.00	
	TOTAL FOR THIS CATEGORY			**3**	**418.39**					**200,500.00**	
135	PUBLIC SERVICE UNIT	UP5/2	MAIN HALL	1	384.00	1986	1987	5		2,000,000.00	
136	PUBLIC SERVICE UNIT	UP5/2	BUKATARIA	1	849.00	1985	1986	4		500,000.00	
137	PUBLIC SERVICE UNIT	UP5/2	AUDITORIUM	1	8.00	1989	1989	3		500,000.00	
	TOTAL FOR THIS CATEGORY			**3**	**1,241.00**					**3,000,000.00**	
138	PUBLIC SERVICE UNIT	UP5/3	CENTRAL CAFT.	1	364.00	1985	1985	4		1,000,000.00	
139	PUBLIC SERVICE UNIT	UP5/3	STAFF SCHOOL	5	1,462.72	1983	1985	3		2,000,500.00	
140	PUBLIC SERVICE UNIT	UP5/3	SPORT CENTRE	1	3,230.00	1986	1986	3		500,000.00	
141	PUBLIC SERVICE UNIT	UP5/3	ZULUKANANI CENT	1	1,138.25	1992	1992	2		2,000,000.00	
142	PUBLIC SERVICE UNIT	UP5/3	SPORTS CENTRE	1	10,908.00	1990	1990	3		3,000,500.00	
	TOTAL FOR THIS CATEGORY			**9**	**17,102.97**					**8,501,000.00**	
143	STAFF/STUDENTS	UP6/1	VC'S LODGE	2	253.00	1994	1994	2		400,000.00	

INVENTORY OF PHYSICAL FACILITIES IN THE FEDERAL UNIVERSITIES/INTER-UNIVERSITY CENTRES OF NIGERIA

UNIVERSITY CODE:183

UNIVERSITY: FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE

S/NO	FACULTY	BLOCK NO	NAME OF BUILDING	NO OF BLOCK IN BUILDING	USABLE FLOOR AREA	YEAR OF COMM	LAST DATE RENOVATED	CONDITION OF BUILDING 1997	CONDITION OF BUILDING 1998	ESTIMATED COST OF REPAIRS 1997	ESTIMATED COST OF REPAIRS 1998
	ACCOMM.										
144	STAFF/STUDENTS ACCOMM.	UP6/1	SSQ 3/ROOM	13	2,467.04			3		5,000,000.00	
145	STAFF/STUDENTS ACCOMM.	UP6/1	SSQ 4/B/ROOM	12	2,484.00	-	-	3		5,000,000.00	
146	STAFF/STUDENTS ACCOMM.	UP6/1	SSQ 5B/ROOMS	1	306.00	-	-	3		0.00	
147	STAFF/STUDENTS ACCOMM.	UP6/1	SSQ FLATS	1	612.00	-	-	3		0.00	
	TOTAL FOR THIS CATEGORY			29	6,122.04					10,400,000.00	
148	STAFF/STUDENTS ACCOMM.	UP6/2	ABIOLA HALL	3	1,662.00	1990	1997	2		1,000,500.00	
149	STAFF/STUDENTS ACCOMM.	UP6/2	JIBOWU HALL	2	1,662.00	1990/95	1997	2		1,000,000.00	
150	STAFF/STUDENTS ACCOMM.	UP6/2	AKINDEKO HALL	7	2,415.00	1987	1997	2		2,000,000.00	
151	STAFF/STUDENTS ACCOMM.	UP6/2	SPJ HALL	1	306.00	1994	1997	2		0.00	
152	STAFF/STUDENTS ACCOMM.	UP6/2	JNR STAFF QRTS	8	104.00	1993	1993	3		2,000,000.00	
	TOTAL FOR THIS CATEGORY			21	6,149.00					6,000,500.00	
	TOTAL FOR THIS UNIVERSITY			120.00	53,753.68					110,305,000.00	

APPENDIX 9/1

DETAILS ON UNIVERSITY CODING

UNICODE	UNIVERSITY NAME
00	NATIONAL UNIVERSITIES COMMISSION, ABUJA
150	UNIVERSITY OF AGRICULTURE, MAKURDI
190	UNIVERSITY OF AGRICULTURE, ABEOKUTA
220	ENUGU STATE UNIVERSITY, ENUGU
230	RIVER STATE UNIVERSITY
240	IMO STATE UNIVERSITY
250	EDO STATE UNIVERSITY
260	ONDO STATE UNIVERSITY
270	OGUN STATE UNIVERSITY, AGO-IWOYE
280	LAGOS STATE UNIVERSITY, LAGOS
300	NIGERIAN DEFENCE ACADEMY, KADUNA
310	LADOKE AKINTOLA UNIVERSITY OF TECHNOLOGY, OGBOMOSHO
320	ABIA STATE UNIVERSITY
340	BAGAUDA UNIVERSITY, KANO
350	DELTA STATE UNIVERSITY, ABRAKA
360	UNIVERSITY OF AGRICULTURE, UMUDIKE
370	BENUE STATE UNIVERSITY
011	UNIVERSITY OF IBADAN, IBADAN
021	UNIVERSITY OF LAGOS, LAGOS
031	UNIVERSITY OF NIGERIA, NSUKKA
041	AHMADU BELLO UNIVERSITY, ZARIA
051	OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE

APPENDIX 9/2

061	UNIVERSITY OF BENIN, BENIN
072	UNIVERSITY OF JOS, JOS
082	UNIVERSITY OF CALABAR, CALABAR
092	BAYERO UNIVERSITY, KANO
102	UNIVERSITY OF MAIDUGURI, MAIDUGURI
112	USMANU DANFODIYO UNIVERSITY, SOKOTO
122	UNIVERSITY OF ILORIN, ILORIN
132	UNIVERSITY OF PORT HARCOURT, PORT HARCOURT
292	UNIVERSITY OF UYO, UYO
332	NNAMDI AZIKIWE UNIVERSITY, AWKA
143	ABUBAKAR TAFAWA BALEWA UNIVERSITY OF TECHNOLOGY, BAUCHI
163	FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI
173	FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
183	FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE
203	FEDERAL UNIVERSITY OF TECHNOLOGY, YOLA
214	UNIVERSITY OF ABUJA, ABUJA
385	NATIONAL MATHEMATICAL CENTRE, ABUJA
395	NIGERIAN FRENCH LANGUAGE VILLAGE, LAGOS
405	NIGERIAN ARABIC VILLAGE, NGALA
415	NIGERIAN NATIONAL LANGUAGE VILLAGE, ABA
425	DIVISION OF AGRICULTURAL COLLEGES, ZARIA

APPENDIX 9/3

FACCODE	FACNAME
01	ADMINISTRATION
02	AGRICULTURE
03	ARTS
04	DENTISTRY
05	EDUCATION
06	ENGINEERING
07	ENV. SCIENCE
08	LAW
09	MEDICINE
10	PHARMACY
11	SCIENCE
12	SOCIAL SCIENCE
13	VET. MEDICINE
14	SCHOOL OF P. G. STUDIES
16	SCHOOL OF REM. AND GEN. STUDIES
15	TEACHING SUPPORT UNIT
17.	ORGANISED RESEARCH UNIT
18	PUBLIC SERVICE UNIT
19	CENTRAL ADMIN
20	STUDENTS/STAFF ACCOMMODATION

Appendix X: NUMERICAL ILLUSTRATION OF THE DERIVED FORMULA AS SHOWN ON PAGE 250

For example: The parameters for a lecture theatre in the University of Benin were computed as follows:

building code	=	Up2/2
X1	=	5,719
X2	=	667,489
X3	=	4
X4	=	817
X5	=	3,268
Cost of repairs	=	1130979+47.88 (5,719)-0.0220 (667,489)
	=	+849 (4)- 468 (817)+121 (3,268)
	=	1130979+273,825.72-14,684.76
	=	+3396-382,356+395,428
	=	₦1,406,587.96
	=	$17,582.35 @ ₦80.0 = $1.0 in 1997

APPENDIX 11

DOLLAR CONVERSION RATES USED FOR THE RESEARCH

S/N	YEAR	EXCHANGE RATE ₦ = $1.0
1	1976	0.63
2	1977	0.65
3	1978	0.61
4	1979	0.60
5	1980	0.55
6	1981	0.60
7	1982	0.67
8	1983	0.72
9	1984	0.76
10	1985	1.00
11	1986	1.27
12	1987	3.96
13	1988	4.21
14	1989	N/A
15	1990	N/A
16	1991	9.73
17	1992	19.76
18	1993	22.00
19	1994	22.00
20	1995	22.00
21	1996	80.00
22	1997	80.00

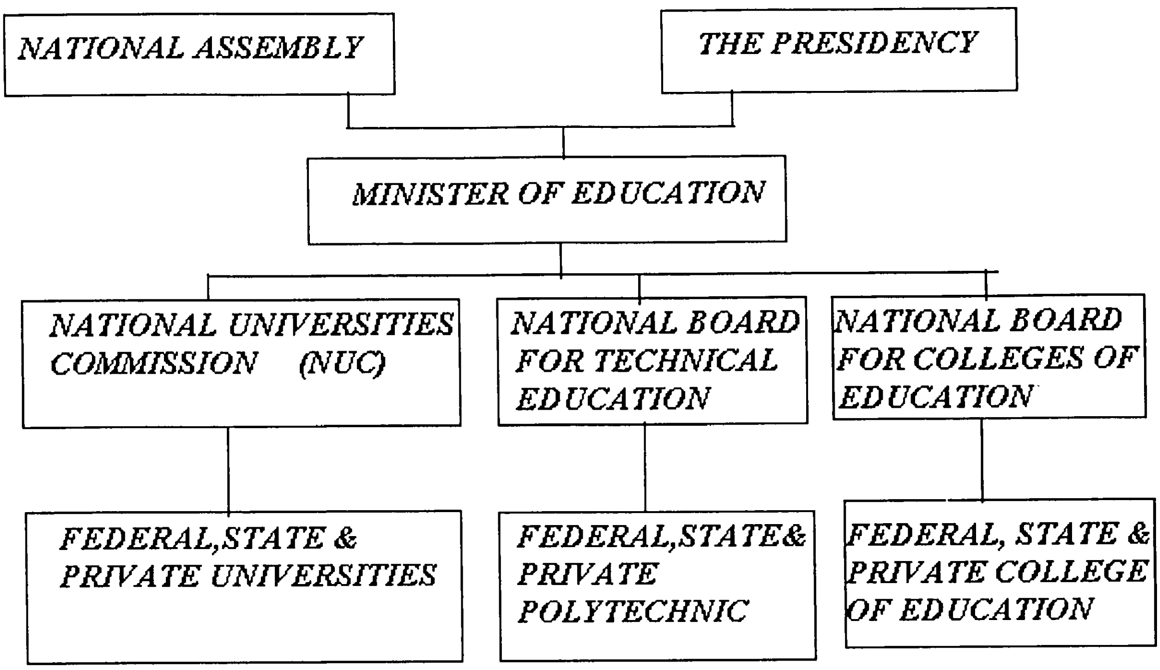
Source: 1976-1988: Effiong, E 1990 *Nigeria Under structural Adjustment* Foundation Publication (p.45), 1991 – 1997: NUC Department of Finance

UNIVERSITIES IN NIGERIA

Name	State	Geographical Zone	Year of Commencement
"First Generation" Federal Universities:			
University of Ibadan	Oyo	South West	1948
University of Nigeria	Enugu	South West	1960
University of Lagos	Lagos	South West	1962
Obafemi Awolowo Univ.	Osun	South West	1962
Ahmadu Bello University	Kaduna	North West	1962
University of Benin	Edo	South South	1970
"Second Generation" Federal Universities:			
Bayero University	Kano	North West	1975
University of Calabar	Cross Rivers	South South	1975
Univeristy of Ilorin	Kwara	North Central	1975
University of Jos	Plateau	North Central	1975
University of Maiduguri	Borono	North East	1975
Usman Danfodio Univ.	Sokoto	North West	1975
Univ. of Port Harcourt	Rivers	South South	1975
"Third Generation" **Federal Universities:**			
Fed. Univ. Tech., Owerri	Imo	South East	1980
Fed. Univ. Tech., Akure	Ondo	South West	1981
Fed. Univ. Tech., Minna	Niger	North Central	1982
Fed. Univ. Tech., Yola	Adamawa	North East	1988
ATBU, Bauchi	Bauchi	North East	1988
University of Abuja	F.C.T.	North East	1988
University of Uyo	Akwa-Ibom	South South	1991
Nnamdi Azikiwe Univ.	Anambra	South East	1992
Federal Univ. Centres			
National Maths. Centre	Abuja FCT	North Central	1992
Nigerian Arabic Language	Borno	North East	1992
Nigerian French Language	Lagos	South West	1992
National Inst of Nig Lang.	Abia	South East	1992

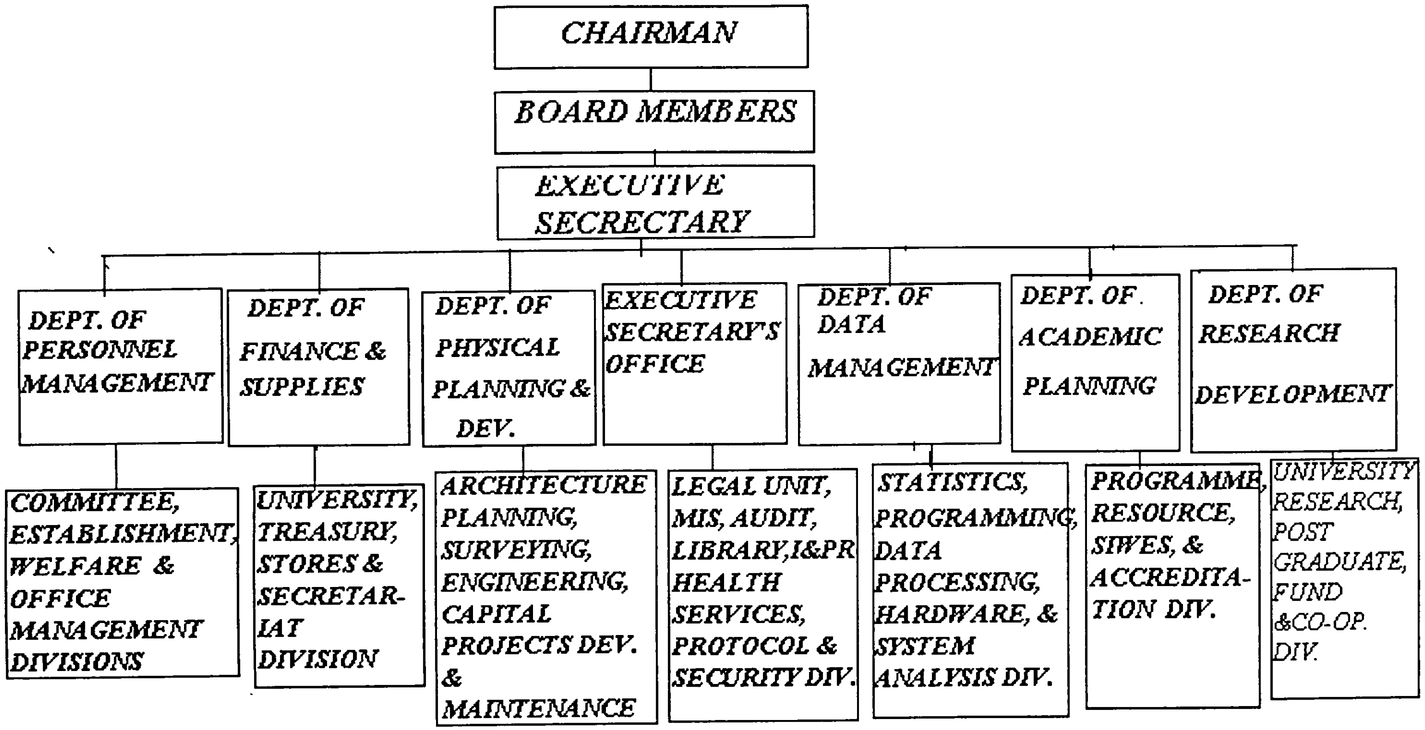
The Specialised (Owned by Federal Government and managed by Federal Ministry of Agriculture)			
Fed. Univ. of Agric.	Abia	South East	1992
Fed. Univ. of Agric.	Benue	North Central	1988
Fed. Univ. of Agric.	Ogun	South West	1988
State Government Universities			
Lagos State University	Lagos	South West	1983
University of Science & Technology, Port Harcourt	Rivers	South South	1979
Edo State University	Edo	South South	1980
Abia State University	Abia	South East	1981
Enugu State University	Enugu	South East	1981
Ogun State University	Ogun	South West	1982
Ekiti State University	Ekiti	South West	1988
Ondo State University	Ondo	South West	1999
Ladoke Akintola Univ.	Oyo	South West	1990
Imo State University	Imo	South East	1992
Benue State |University	Benue	North Central	1992
Delta State University	Delta	South South	1992
Kogi State University	Kogi	North Central	1999
Ebonyi State University	Ebonyi	South East	1999
Private Universities			
Babcock University	Ogun	South West	1999
Madona University	Anambra	South East	1999
Igbinedion University	Edo	South South	1999
Heritage University	Kaduna	North West	1999

ADMINISTRATION OF HIGHER EDUCATIONAL SYSTEM IN NIGERIA



APPENDIX 14

THE NATIONAL UNIVERSITIES COMMISSION (NUC), ABUJA



Appendix 15/1

BUILDING IN CONDITION- 2

. MEANS SATISFACTORY WITH ONLY MINOR DETERIORATION WHICH WOULD REQUIRES SMALLER AMOUNT OF MONEY .

.MINOR REPAIRS HERE INCLUDE SUCH ITEMS LIKE REPLACEMENT OF DOOR LOCK, SKIRTING AND BROKEN GLASS PANELS

Appendix 15/2

BUILDING IN CONDITION- 3

- MEANS, SAFE BUT SIGNS OF FAST DETERIORATION ARE SHOWN ON SOME OF THE ELEMENTS AND WOULD REQUIRED REASONABLE AMOUNT OF MONEY TO REPAIR .
- THE SIGN OF DETERIORATION HERE INCLUDES THE EFFECT OF WEATHER ON EXTERNAL PAINTING, REPLACEMENT OF PLUMBING FITTINGS AND ELECTRICAL FITTINGS.

Appendix 15/3

BUILDING IN CONDITION- 4

. MEANS, OPERATIONAL BUT MAJOR REPAIRS AND REPLACEMENT OF KEY ELEMENTS WILL BE NECSSARY WITHIN A REASONABLE SHORT PERIOD.

. REPLACEMENT OF SOME KEY ELEMENTS HERE INCLUDES THAT OF CEILING AFFECTED BY THE EFFECT OF LEAKING ROOF WHICH WAS PREVIOUSLY CORRECTED, EXTERNAL PAINTING AND RE-DECORATION AND REPLACEMENT OF MANY DOORS AND WINDOWS.

Appendix 15/4

BUILDING IN CONDITION- 5

. MEANS, INOPERABLE AND REQUIRES WORK ON MANY ELEMENTS.

. WORK ON MANY ELEMENTS HERE INCLUDE THAT OF THE ENTIRE CEILING, INTERNAL PAINTING AND DECORATION, PLUMBING AND ELECTRICAL FITTINGS.

Appendix 15/5

BUILDING IN CONDITION- 6

. MEANS, INOPERABLE AND AND UNSAFE UNTIL MAJOR ELEMENTS ARE REPLACED.

. UNSAFE HERE INCLUDE SIGN OF CRACKS SHOWING ON THE STRUCTURAL ELEMENTS, COLLAPSE OF PART OF THE ROOF STRUCTURE AND SO ON.

GLOSSARY

Block Grants	-	**Funds allocation by the Federal Government in block in a given financial year for both recurrent and capital expenditure.**
Conventional Universities	-	**Universities offering general programmes in Arts, pure Science, Applied Science, Law and Medicine**
Dollar ($)	-	**United States of America's dollar**
F.T.E. Student	-	**Full Time Equivalent student (student offering university's courses on full time basis)**
First Generation Universities (FGU)	-	**Nigerian Federal Universities established between 1948 – 1970**
Fourth Generation University	-	**Nigerian Federal University established in 1988, at Abuja**
Fund Allocation	-	**Process of disbursing funds to the Federally controlled universities excepting the Federal universities of Agriculture, state and private universities.**
Infrastructure	-	**Consists of Buildings, for academic and students' residence**
Naira (N)	-	**The currency for the Federal Republic of Nigeria.**
Nigeria	-	**A country situated in the West Coast of Africa, lying between longitudes 3^0E and 15^0E, latitudes 4^0N and 14^0N. It operates a Federal system of constitution like that of the United States of America and has a total number of 36 States plus Abuja, Federal Capital Territory**
NUC	-	**National Universities Commission established in 1962 to supervise the academic standards of all universities as well as to manage the funding of Federal Ministry of Education – managed Federal Universities**
Second Generation Universities (SGU)	-	**Nigerian Federal Universities established in 1975**
Third Generation Universities	-	**Nigerian Federal Universities established between 1980–1982**
Universities of Technology	-	**Universities offering courses in Environmental Technology, Engineering, and Agriculture and Agricultural Technology.**
Universities of Agriculture:	-	**Universities offering courses only in Agriculture and Agricultural related disciplines**
University Centres	-	**Specialised institutions granted university status and which specialise on the teaching and research in languages and mathematics.**
Weighted Space	-	**Space required by Full Time Equivalent students for a particular programme.**